

U. S. Department of Agriculture  
Soil Conservation Service  
National Engineering Staff

April 1981 (Rev. 1)

Design Note No. 18\*

Subject: "Unattached" ES drawings

Most Engineering Standard (ES) drawings are contained, because of their subject matter, in either sections of the national engineering handbook, technical releases, design notes, or other similar publications. Thus, such ES drawings are available by procurement of the publications in which they appear.

This design note provides a mechanism by which otherwise "unattached" ES drawings may be obtained.

These "unattached" ES drawings are contained herein. They group naturally into three categories. These are:

Group A: Schedules of National Standard Detail Drawings

- ES- 94 Series "B" Straight Drop Spillways
- ES-169 Standard Covered Risers
- ES-180 Standard Open Risers
- ES-186 Standard Impact Basins (also available in TR-49)
- ES-195 Standard Conduit Details
- ES-231 Standard Baffle Risers

Group B: Drop Inlet Spillway Standards

- ES-150 Covered Top Riser
- ES-151 Rectangular Open Top Riser
- ES-152 Square Open Top Riser
- ES-153 Restricted Flow Riser
- ES-154 Pipe Conduits
- ES-155 Pipe Conduit Outlets
- ES-156 Low Stage Inlets
- ES-232 Baffle Top Riser

Group C: Miscellaneous

- ES- 8 Circular Curve Pipe Layout Information
- ES- 11 Drop Spillway Nappe
- ES-157 Properties of Steel Angles with Equal Legs

\*Prepared by Edwin S. Alling, Head, Design Unit, National Engineering Staff, Lanham, Maryland.



**STANDARD PLANS: SERIES "B" REINFORCED CONCRETE DROP SPILLWAYS SCHEDULE SHOWING DRAWING NUMBER, CUBIC YARDS OF CONCRETE, AND POUNDS OF REINFORCING STEEL.**

F	$h \setminus L$	6	8	10	12	14	16	18	20	22	24	26	28	30	
5	2-6	2051-6B 19.98 1400.47	2051-8B 21.32 1591.36	2051-10B 22.66 1833.29	2051-12B 24.13 1757.87	2051-14B 25.47 1882.85	2051-16B 26.81 1947.69	2051-18B 28.15 2148.58	2051-20B 29.49 2206.85	2051-22B 30.83 2376.90	2051-24B 32.17 2436.30	2051-26B 33.51 2548.91	2051-28B 34.84 2708.46	2051-30B 36.18 2923.96	
	3-0	2052-6B 24.36 1975.81	2052-8B 25.78 2167.93	2052-10B 27.20 2416.75	2052-12B 28.79 2313.39	2052-14B 30.21 2464.78	2052-16B 31.63 2559.55	2052-18B 33.05 2720.18	2052-20B 34.46 2830.36	2052-22B 35.88 2966.63	2052-24B 37.30 3117.16	2052-26B 38.72 3230.65	2052-28B 40.14 3368.08	2052-30B 41.56 3551.59	
	3-6											2053-24B 43.06 3457.51	2053-26B 44.56 3635.43	2053-28B 46.05 3812.61	2053-30B 47.55 4023.02
6	2-6	2061-6B 21.08 1601.43	2061-8B 22.50 1767.24	2061-10B 23.92 2034.92	2061-12B 25.49 1973.92	2061-14B 26.91 2092.83	2061-16B 28.33 2206.57	2061-18B 29.75 2433.87	2061-20B 31.17 2532.58	2061-22B 32.59 2734.61	2061-24B 34.01 2830.03	2061-26B 35.43 2986.35	2061-28B 36.85 3167.85	2061-30B 38.27 3405.80	
	3-0	2062-6B 25.64 2103.37	2062-8B 27.14 2283.59	2062-10B 28.64 2592.72	2062-12B 30.33 2484.08	2062-14B 31.83 2626.73	2062-16B 33.33 2814.70	2062-18B 34.83 3023.87	2062-20B 36.33 3111.19	2062-22B 37.83 3309.80	2062-24B 39.33 3485.58	2062-26B 40.83 3622.58	2062-28B 42.33 3817.95	2062-30B 43.83 4055.17	
	3-6											2063-24B 45.77 3961.17	2063-26B 47.36 4173.51	2063-28B 48.96 4424.57	2063-30B 50.55 4660.84
	4-0	2064-6B* 36.70 3294.86	2064-8B 38.38 3405.15	2064-10B 40.05 3523.83	2064-12B 42.02 3545.15	2064-14B 43.69 3824.54	2064-16B 45.36 4033.21	2064-18B 47.04 4186.48	2064-20B 48.71 4434.64	2064-22B 50.38 4544.86	2064-24B 52.05 4802.44	2064-26B 53.73 4967.94	2064-28B 55.40 5392.81	2064-30B 57.07 5511.74	
7	2-6	2071-6B 24.13 1770.40	2071-8B 25.64 1962.20	2071-10B 27.15 2281.97	2071-12B 28.81 2133.03	2071-14B 30.33 2291.06	2071-16B 31.84 2494.10	2071-18B 33.35 2630.02	2071-20B 34.86 2795.37	2071-22B 36.37 2983.80					
	3-0	2072-6B 27.21 2305.84	2072-8B 28.81 2594.80	2072-10B 30.41 2971.44	2072-12B 32.20 2768.75	2072-14B 33.79 2985.86	2072-16B 35.39 3108.17	2072-18B 36.98 3296.11	2072-20B 38.58 3456.31	2072-22B 40.17 3683.76	2072-24B 41.77 3934.27	2072-26B 43.37 4104.64	2072-28B 44.96 4308.07	2072-30B 46.56 4638.52	
	3-6											2073-24B 47.94 4606.59	2073-26B 49.62 4881.46	2073-28B 51.29 5103.44	2073-30B 52.97 5389.76
	4-0	2074-6B* 38.72 3517.19	2074-8B 40.49 3818.79	2074-10B 42.26 4322.34	2074-12B 44.34 4060.57	2074-14B 46.11 4324.97	2074-16B 47.88 4435.01	2074-18B 49.65 4679.42	2074-20B 51.41 4941.73	2074-22B 53.18 5356.99	2074-24B 54.95 5614.07	2074-26B 56.72 5842.35	2074-28B 58.49 6158.87	2074-30B 60.25 6465.29	
	4-6											2075-26B 64.60 6608.62	2075-28B 66.44 6902.07	2075-30B 68.29 7270.07	
	5-0	2076-6B* 51.60 5758.48	2076-8B* 53.32 6063.63	2076-10B 55.45 6506.82	2076-12B 57.83 6374.43	2076-14B 59.76 6630.05	2076-16B 61.69 6866.32	2076-18B 63.61 7137.31	2076-20B 65.54 7383.82	2076-22B 67.47 7891.14	2076-24B 69.39 8221.24	2076-26B 72.01 7986.59	2076-28B 73.93 8195.88	2076-30B 75.86 8441.24	
8	2-6	2081-6B 28.52 2286.72	2081-8B 30.11 2580.93	2081-10B 31.70 2894.57											
	3-0	2082-6B 30.00 2606.59	2082-8B 31.67 2933.42	2082-10B 33.35 3393.86	2082-12B 35.22 3166.00	2082-14B 36.90 3418.33	2082-16B 38.57 3621.84	2082-18B 40.24 3842.53	2082-20B 41.92 4035.89	2082-22B 43.59 4296.86	2082-24B 45.26 4796.48	2082-26B 46.93 4846.29	2082-28B 49.45 5147.78	2082-30B 51.12 4800.91	
	3-6											2083-24B 46.92 4835.15	2083-26B 48.69 5148.68	2083-28B 50.45 5314.69	2083-30B 52.22 5673.64
	4-0	2084-6B* 40.29 3942.57	2084-8B 42.14 4290.39	2084-10B 43.99 4667.26	2084-12B 46.17 4568.02	2084-14B 48.02 4859.58	2084-16B 49.87 5001.22	2084-18B 51.71 5440.11	2084-20B 53.56 5692.84	2084-22B 55.41 5976.66	2084-24B 57.26 6143.37	2084-26B 59.96 6431.76	2084-28B 61.81 6335.72	2084-30B 63.66 6667.19	
	4-6											2085-26B 67.43 7648.31	2085-28B 69.36 8050.62	2085-30B 71.28 8319.20	
	5-0	2086-6B* 54.03 6732.94	2086-8B* 56.05 7031.27	2086-10B 58.07 7596.94	2086-12B 60.57 7400.45	2086-14B 62.59 7687.53	2086-16B 64.61 7941.71	2086-18B 66.63 8353.59	2086-20B 68.66 8708.75	2086-22B 71.61 8487.16	2086-24B 73.64 8903.10	2086-26B 75.66 9273.94	2086-28B 77.68 9698.10	2086-30B 79.70 10130.08	
9	2-6	2091-6B 33.56 2886.37	2091-8B 35.54 3156.72	2091-10B 37.09 3283.05											
	3-0	2092-6B 35.02 3165.85	2092-8B 36.79 3575.92	2092-10B 38.77 3596.27	2092-12B 40.54 3853.91	2092-14B 42.31 4148.74	2092-16B 44.08 4398.32	2092-18B 45.85 4672.12	2092-20B 47.62 4995.58	2092-22B 50.50 4669.28	2092-24B 52.27 4889.04	2092-26B 54.03 5168.69	2092-28B 55.80 5478.30	2092-30B 57.57 5825.39	
	3-6	2093-6B* 36.91 3685.64	2093-8B 38.76 4022.45	2093-10B 40.61 4454.10	2093-12B 42.74 4405.53	2093-14B 44.59 4649.63	2093-16B 46.44 5068.80	2093-18B 48.28 5268.80	2093-20B 50.13 5668.76	2093-22B 52.09 5927.76	2093-24B 54.94 5916.74	2093-26B 56.79 6187.86	2093-28B 58.64 6559.76		
	4-0	2094-6B* 41.81 4376.42	2094-8B 43.74 4718.70	2094-10B 45.68 5193.83	2094-12B 47.95 5067.65	2094-14B 49.88 5335.07	2094-16B 51.81 5644.16	2094-18B 53.74 6034.57	2094-20B 55.60 5782.65	2094-22B 58.73 6148.78	2094-24B 60.66 6327.49	2094-26B 62.59 6602.44	2094-28B 64.52 7022.40	2094-30B 66.46 7406.17	
	4-6											2095-26B 67.43 8571.17	2095-28B 70.76 8964.40	2095-30B 72.79 9317.86	
	5-0	2096-6B* 55.92 7504.69	2096-8B* 58.02 7844.56	2096-10B 60.12 8305.86	2096-12B 62.72 8286.26	2096-14B 64.83 8639.17	2096-16B 66.93 9017.95	2096-18B 69.03 9353.63	2096-20B 72.27 9178.51	2096-22B 74.37 9509.13	2096-24B 76.48 9827.44	2096-26B 78.58 10311.98	2096-28B 80.69 10693.95	2096-30B 82.79 10990.97	

(1) Notes: Drawing No., cu. yds of concrete, and lbs.. of reinforcing steel are listed vertically in order for each size. Each drawing number shall be prefixed with the letters E. S.

(2) \*The ratio of  $L + h$  is less than 2.0 for these values. Correction for hydraulic losses due to end contractions must be considered in the solution of the weir formula, for discharge capacity, before these drop spillways can be applied.

**STANDARD PLANS: SERIES "B" REINFORCED CONCRETE DROP SPILLWAYS SCHEDULE SHOWING DRAWING NUMBER, CUBIC YARDS OF CONCRETE, AND POUNDS OF REINFORCING STEEL.**

F	$\frac{L}{h}$	6	8	10	12	14	16	18	20	22	24	26	28	30
10	2-6	2101-6B 38.50 3653.89	2101-8B 40.25 4079.57	2101-10B 42.19 4038.44										
	3-0	2102-6B 40.07 4051.02	2102-8B 41.91 4409.92	2102-10B 43.98 4515.45	2102-12B 45.83 4837.60	2102-14B 47.67 5188.38	2102-16B 49.52 5502.04	2102-18B 52.69 5271.26	2102-20B 54.54 5458.22	2102-22B 56.38 5714.65	2102-24B 58.23 6102.21	2102-26B 60.08 6335.89	2102-28B 61.92 6707.70	2102-30B 63.77 7270.23
	3-6			2103-10B 46.81 5104.70	2103-12B 48.75 5398.62	2103-14B 50.69 5790.70	2103-16B 52.64 6181.37							
	4-0	2104-6B* 44.76 4979.57	2104-8B* 46.78 5515.76	2104-10B 49.16 5617.58	2104-12B 51.18 5780.68	2104-14B 53.20 6222.16	2104-16B 55.22 6600.50	2104-18B 58.59 6379.79	2104-20B 60.61 6601.14	2104-22B 62.63 6853.84	2104-24B 64.65 7270.83	2104-26B 66.68 7685.13	2104-28B 68.72 8035.65	2104-30B 70.72 8492.21
	4-6												2105-26B 73.48 9288.91	2105-28B 75.58 9723.46
	5-0	2106-6B* 58.26 8337.86	2106-8B* 60.46 8704.38	2106-10B 62.66 9185.84	2106-12B 65.37 9190.06	2106-14B 67.37 9671.24	2106-16B 69.77 10099.38	2106-18B 73.42 9802.47	2106-20B 75.62 10047.62	2106-22B 77.82 10525.47	2106-24B 80.02 10851.85	2106-26B 82.22 11492.03	2106-28B 84.42 11969.87	2106-30B 86.62 12376.95
	6-0	2108-6B* 76.54 12355.69	2108-8B* 78.97 12507.68	2108-10B* 81.40 13199.52	2108-12B 84.53 13268.52	2108-14B 86.96 13950.67	2108-16B 89.39 14502.72	2108-18B 93.18 14030.46	2108-20B 95.62 14338.86	2108-22B 98.05 14889.07	2108-24B 100.48 15265.29	2108-26B 102.91 15559.54	2108-28B 105.53 15803.93	2108-30B 108.45 16180.56

(1) Notes: Drawing No., cu. yds of concrete, and lbs.. of reinforcing steel are listed vertically in order for each size. Each drawing number shall be prefixed with the letters E. S.

(2) \*The ratio of L + h is less than 2.0 for these values. Correction for hydraulic losses due to end contractions must be considered in the solution of the weir formula, for discharge capacity, before these drop spillways can be applied.

**Definition of Symbols:**

F = net drop from crest of weir to top of transverse sill in ft  
h = total depth of weir in ft

L = length of weir in ft

**Load Assumptions:**

- Weight of concrete = 150 lbs/ft<sup>3</sup>
- Weight of earth fill = 100 lbs/ft<sup>3</sup>
- Weight of equivalent fluid against headwall = 62.4 lbs/ft<sup>3</sup>
- Weight of equivalent fluid against sidewalls = 35 lbs/ft<sup>3</sup>
- Weight of equivalent fluid against wingwalls = 35 lbs/ft<sup>3</sup>
- Weight of equivalent fluid against headwall extensions = 5 lbs/ft<sup>3</sup>
- Allowable soil bearing pressure = 2000 lbs/ft<sup>2</sup>

**Allowable unit working stresses (Class B Concrete):**

- Ultimate compressive strength  $f'_c$  = 3000 lbs/sq in.
- Extreme fiber stress in compression  $f_c$  = 1200 lbs/sq in.
- Working stress for reinforcing steel  $f_s$  = 20,000 lbs/sq in.

REFERENCE

U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

ENGINEERING DIVISION-DESIGN SECTION

STANDARD DWG. NO.

**ES-94**

SHEET 2 OF 2

DATE 10-6-54

# STANDARD PLANS: STANDARD COVERED RISERS SELECTION OF STANDARD DETAIL DRAWINGS

## Key to Drawing Numbers

The drawing numbers of the Standard Detail Drawings for Standard Covered Risers are given by:

ES-30DD-[NN]<sub>ih</sub>[NN]<sub>is</sub>[E]<sub>R</sub>

where

DD      ≡ D    = pipe conduit diameter, inches.

[NN]<sub>ih</sub> ≡ N<sub>ih</sub> = vertical distance from pipe invert at the riser to crest of the covered inlet of the riser, ft.

[NN]<sub>is</sub> ≡ N<sub>is</sub> = vertical distance from pipe invert at the riser to soil surface, ft. The soil surface is either the sediment or the embankment (berm) surface.

[E]<sub>R</sub>    ≡      riser is designed to be located in the [embankment reservoir area].

## Standard Detail Drawings

Each set of Standard Detail Drawings for a Standard Covered Riser consists of four sheets. Each Standard Covered Riser is designed for a specific combination of N<sub>ih</sub> and N<sub>is</sub>.

A set of Standard Detail Drawings may be adapted to a range of riser heights. The height may vary from the full design height given by N<sub>ih</sub> in the drawing number to five feet less than N<sub>ih</sub>. The only exception to the preceding statement occurs with risers having D = 36 in. and N<sub>ih</sub> = 15 ft, for which the height range is four feet.

The design combinations of N<sub>ih</sub>, N<sub>is</sub>, and N<sub>sh</sub> for each pipe conduit diameter together with criteria for selecting the Standard Detail Drawings to be used for a given adaptation, are given on sheet 2 of this drawing.

## Adaptation of Standard Detail Drawings

After the particular Standard Detail Drawings to be used have been selected, they must be adapted to the desired riser height. The adaptation is accomplished by completing the fill-ins left blank on sheets 1 and 3 of the drawings. The information required is self-explanatory. It consists of vertical dimensions, reinforcement bar lengths, reinforcement bar quantities, and volumes and weights of materials.

## Volumes and Weights of Materials

Quantity schedules for each family of Standard Covered Risers are contained on the following sheets of this drawing:

Pipe Conduit Diameter	Sheet
D = 24 in.	3
30	4
36	5
42	6
48	7

## Wind Projections

Risers to be located in the embankment are not designed for wind. An allowable wind projection is tabulated for these risers on the sheets containing the quantity schedules. The tabulated allowable wind projection was computed for the conditions:

- (1) No embankment is placed in the vicinity of the riser.
- (2) Moist soil condition, allowable earth bearing pressures are:

P<sub>max</sub> ≤ 4 ksf

Paver ≤ 2 ksf

P<sub>min</sub> ≥ 0 ksf

- (3) Wind acts on the sidewall at 50 psf.

- (4) The constructed riser height, above the top of the footing, does not exceed the allowable wind projection.

The assumption is made that the allowable wind projection for other conditions of embankment placement and riser height is not less than that tabulated. Thus, the tabulated allowable wind projection may be considered as the allowable vertical distance between the surface of the embankment and the top of the riser at any stage of construction.

## REFERENCE

SCS Engineering Memo. - 50  
SCS Technical Release - 29  
SCS Technical Release - 30

U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE  
ENGINEERING DIVISION - DESIGN UNIT

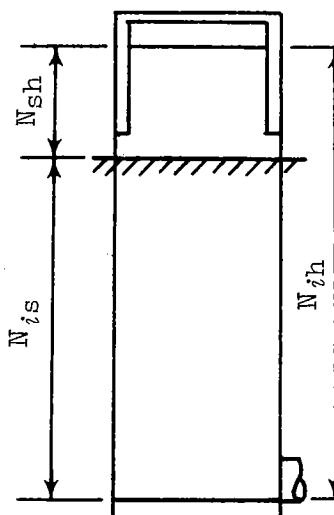
## STANDARD DWG. NO.

ES- 169

SHEET 1 OF 7

DATE 7-65

**STANDARD PLANS: STANDARD COVERED RISERS  
SELECTION OF STANDARD DETAIL DRAWINGS**



Selection of Standard Detail Drawings

The selection of the particular Standard Detail Drawings to be adapted to the desired riser height is made as follows:

The  $N_{ih}$  of the Standard Detail Drawings to be selected is the smallest value of  $N_{ih}$  which is greater than or equal to the  $N_{ih}$  desired at the specific site and the  $N_{sh}$  of the Standard Detail Drawings to be selected is the greatest value of  $N_{sh}$  which is less than or equal to the  $N_{sh}$  desired at the specific site.

Thus:

$N_{ih}$  of the standard  $\geq N_{ih}$  desired at specific site

$N_{sh}$  of the standard  $\leq N_{sh}$  desired at specific site.

Four examples are given. These examples assume a 36 in. pipe conduit diameter and risers will be located in the embankment.

Example 1.

$N_{ih}$  desired = 30.0',  $N_{sh}$  desired = 13.0', therefore  
select ES-3036 - 3020E

Example 2.

$N_{ih}$  desired = 28.5',  $N_{sh}$  desired = 13.0', therefore  
select ES-3036 - 3020E

Example 3.

$N_{ih}$  desired = 27.0',  $N_{sh}$  desired = 13.0', therefore  
select ES-3036 - 3020E

Example 4.

$N_{ih}$  desired = 27.0',  $N_{sh}$  desired = 15.0', therefore  
select ES-3036 - 3015E.

REFERENCE

SCS Engineering Memo. - 50  
SCS Technical Release - 29  
SCS Technical Release - 30

U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE  
ENGINEERING DIVISION - DESIGN UNIT

STANDARD DWG. NO.

ES- 169

SHEET 2 OF 7

DATE 7-65

**STANDARD PLANS: STANDARD COVERED RISERS  
SCHEDULE SHOWING DRAWING NUMBERS, VOLUMES  
OF CONCRETE, AND WEIGHTS OF STEEL.**

**PIPE  
CONDUIT  
DIAMETER  
= 24 "**

STANDARD DETAIL DRAWINGS, ES-3024-[NN] <sub>i_h</sub> [NN] <sub>i_s</sub> [E] <sub>R</sub>								
$N_{ih}$ feet	RISERS TO BE LOCATED IN RESERVOIR AREA				RISERS TO BE LOCATED IN EMBANKMENT			
	$N_{sh} = N_{ih} - N_{is}$ , feet				$N_{sh} = N_{ih} - N_{is}$ , feet			
	5	10	15	20	5	10	15	20
40	4035R 41.45 0.97 7848 187	4030R 38.40 0.74 7550 206	4025R 39.00 0.74 7471 206	4020R 40.20 0.74 6588 167	4035E 57.55 0.97 11036 213 25	4030E 44.90 0.74 8434 218 19	4025E 38.00 0.74 7322 206 14	4020E 34.60 0.74 6106 167 9
	3530R 33.60 0.74 6035 206	3525R 33.60 0.74 5979 167	3520R 33.10 0.74 5977 167	3515R 33.30 0.60 4999 191	3530E 42.40 0.74 8064 218 19	3525E 35.50 0.74 6227 167 16	3520E 32.20 0.74 5667 167 10	3515E 28.20 0.60 6183 191 9
	3025R 29.20 0.74 5318 167	3020R 27.80 0.60 4957 154	3015R 28.20 0.60 4826 154	3010R 27.90 0.60 4595 118	3025E 32.20 0.74 5841 167 15	3020E 27.80 0.60 4935 154 10	3015E 25.30 0.60 4366 154 8	3010E 24.00 0.60 3980 118 14
	2520R 22.90 0.60 4298 154	2515R 22.90 0.60 3733 118	2510R 24.10 0.60 3857 116	2505R 24.10 0.60 3725 101	2520E 24.90 0.60 4454 154 11	2515E 21.50 0.60 3625 118 9	2510E 20.70 0.60 3372 116 12	2505E 21.30 0.60 3330 101 17
20	2015R 18.60 0.60 3095 116	2010R 18.60 0.60 2893 98	2005R 18.90 0.60 2817 87	-	2015E 18.70 0.60 3045 116 9	2010E 17.80 0.60 2783 98 12	2005E 18.10 0.60 2622 87 15	-
	1510R 15.10 0.60 2253 84	1505R 15.00 0.60 2279 78	-	-	1510E 14.80 0.60 2212 84 13	1505E 14.80 0.60 2247 78 13	-	-

Items, listed in vertical order per riser:

- (1) Partial drawing number - [NN]<sub>i\_h</sub> [NN]<sub>i\_s</sub> [E]<sub>R</sub>
- (2) Volume of concrete for full height riser,  $N_{ih}$  equals tabulated value, cu. yds.
- (3) Change in volume of concrete per foot decrease in height of riser, cu. yds.
- (4) Weight of steel for full height riser,  $N_{ih}$  equals tabulated value, lbs.
- (5) Approximate change in weight of steel per foot decrease in height of riser, lbs.
- (6) Allowable wind projection, see sheet 1 of this drawing, feet.

REFERENCE	U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE ENGINEERING DIVISION - DESIGN UNIT	STANDARD DWG. NO. ES- 169 SHEET 3 OF 7 DATE 8-66
SCS Engineering Memo. - 50 SCS Technical Release - 29 SCS Technical Release - 30		

**STANDARD PLANS: STANDARD COVERED RISERS  
SCHEDULE SHOWING DRAWING NUMBERS, VOLUMES  
OF CONCRETE, AND WEIGHTS OF STEEL.**

**PIPE  
CONDUIT  
DIAMETER  
= 30 "**

STANDARD DETAIL DRAWINGS, ES-3030-[NN] <sub>i_h</sub> [NN] <sub>i_S</sub> [ $\frac{E}{R}$ ]								
$N_{i_h}$ feet	RISERS TO BE LOCATED IN RESERVOIR AREA				RISERS TO BE LOCATED IN EMBANKMENT			
	$N_{sh} = N_{i_h} - N_{i_S}$ , feet				$N_{sh} = N_{i_h} - N_{i_S}$ , feet			
	5	10	15	20	5	10	15	20
40	4035R	4030R	4025R	4020R	4035E	4030E	4025E	4020E
	51.97	51.48	51.82	50.07	69.37	56.86	53.23	48.12
	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
	10389	10036	9420	9674	13665	11160	9433	8867
	276	276	232	232	303	276	232	232
					27	22	23	20
35	3530R	3525R	3520R	3515R	3530E	3525E	3520E	3515E
	44.51	44.51	45.07	42.38	51.91	47.22	44.85	38.91
	1.16	1.16	1.16	0.89	1.16	1.16	1.16	0.89
	8533	8116	8144	7597	9908	8612	7952	6871
	232	220	194	198	232	220	194	198
					20	20	21	16
30	3025R	3020R	3015R	3010R	3025E	3020E	3015E	3010E
	36.83	36.83	35.43	33.96	40.11	38.05	35.12	31.54
	0.89	0.89	0.89	0.72	0.89	0.89	0.72	0.72
	7106	6511	6805	6319	7578	6600	6214	5688
	240	198	198	181	240	198	198	181
					21	20	13	17
25	2520R	2515R	2510R	2505R	2520E	2515E	2510E	2505E
	30.50	29.03	29.47	28.83	31.82	27.79	27.49	27.63
	0.89	0.72	0.72	0.72	0.89	0.72	0.72	0.72
	5533	5263	5118	5032	5728	5086	4767	4762
	162	181	148	138	162	181	148	138
					14	15	15	19
20	2015R	2010R	2005R		2015E	2010E	2005E	
	23.49	23.61	23.61		23.93	22.65	22.99	
	0.72	0.72	0.72		0.72	0.72	0.72	
	4363	4049	3713		4480	3897	3599	
	148	141	111		148	141	111	
					13	14	18	
15	1510R	1505R			1510E	1505E		
	19.04	19.04			19.04	19.04		
	0.72	0.72			0.72	0.72		
	3087	2880	-	-	3087	2845	-	-
	111	94			111	94		
					> 17	> 17		

Items, listed in vertical order per riser:

- (1) Partial drawing number - [NN]<sub>i\_h</sub>[NN]<sub>i\_S</sub> [ $\frac{E}{R}$ ]
- (2) Volume of concrete for full height riser,  $N_{i_h}$  equals tabulated value, cu. yds.
- (3) Change in volume of concrete per foot decrease in height of riser, cu. yds.
- (4) Weight of steel for full height riser,  $N_{i_h}$  equals tabulated value, lbs.
- (5) Approximate change in weight of steel per foot decrease in height of riser, lbs.
- (6) Allowable wind projection, see sheet 1 of this drawing, feet.

**REFERENCE**

SCS Engineering Memo. - 50  
SCS Technical Release - 29  
SCS Technical Release - 30

**U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE  
ENGINEERING DIVISION - DESIGN UNIT**

**STANDARD DWG. NO.**

**ES- 169**

**SHEET 4 OF 7**

**DATE 1 - 66**

**STANDARD PLANS: STANDARD COVERED RISERS  
SCHEDULE SHOWING DRAWING NUMBERS, VOLUMES  
OF CONCRETE, AND WEIGHTS OF STEEL.**

**PIPE  
CONDUIT  
DIAMETER  
= 36 "**

STANDARD DETAIL DRAWINGS; ES-3036-[NN]<sub>ih</sub> [NN]<sub>is</sub> [E]<sub>R</sub>

N <sub>ih</sub> feet	RISERS TO BE LOCATED IN RESERVOIR AREA				N <sub>sh</sub> = N <sub>ih</sub> - N <sub>is</sub> , feet	RISERS TO BE LOCATED IN EMBANKMENT				
	N <sub>sh</sub> = N <sub>ih</sub> - N <sub>is</sub> , feet					N <sub>sh</sub> = N <sub>ih</sub> - N <sub>is</sub> , feet				
	5	10	15	20		5	10	15	20	
40	4035R	4030R	4025R	4020R	N <sub>sh</sub> = N <sub>ih</sub> - N <sub>is</sub> , feet	4035E	4030E	4025E	4020E	
	69.35	71.55	69.35	64.45		86.45	80.05	71.15	60.25	
	1.67	1.67	1.67	1.35		1.67	1.67	1.67	1.35	
	13288 338	12319 269	11385 269	11981 306		15936 360 30	13131 269 32	11486 269 25	11529 306 22	
35	3530R	3525R	3520R	3515R	N <sub>sh</sub> = N <sub>ih</sub> - N <sub>is</sub> , feet	3530E	3525E	3520E	3515E	
	61.15	56.25	57.05	54.45		71.45	59.55	56.95	51.85	
	1.67	1.35	1.35	1.35		1.67	1.35	1.35	1.35	
	10766 269	10872 306	9635 263	9819 257		11945 269 26	11200 306 25	9693 263 24	9412 257 27	
30	3025R	3020R	3015R	3010R	N <sub>sh</sub> = N <sub>ih</sub> - N <sub>is</sub> , feet	3025E	3020E	3015E	3010E	
	50.55	48.65	49.25	45.50		54.75	49.75	48.15	42.90	
	1.35	1.35	1.35	1.04		1.35	1.35	1.35	1.04	
	8975 263	8710 272	8078 208	8474 231		9432 263 22	8833 272 21	7857 208 20	7896 231 22	
25	2520R	2515R	2510R	2505R	N <sub>sh</sub> = N <sub>ih</sub> - N <sub>is</sub> , feet	2520E	2515E	2510E	2505E	
	39.70	39.70	38.10	36.35		40.70	40.10	36.10	34.75	
	1.04	1.04	1.04	0.85		1.04	1.04	1.04	0.85	
	7263 227	6995 231	6441 178	6263 169		7373 227 17	7030 231 17	6194 178 18	6049 169 20	
20	2015R	2010R	2005R		N <sub>sh</sub> = N <sub>ih</sub> - N <sub>is</sub> , feet	2015E	2010E	2005E		
	31.05	31.05	30.45	30.45		30.55	29.85	28.85		
	0.85	0.85	0.85	0.85		0.85	0.85	0.85		
	5829 185	5363 169	5038 146	-		5778 185 12	5228 169 18	4842 146 16	-	
15	1510R	1505R			N <sub>sh</sub> = N <sub>ih</sub> - N <sub>is</sub> , feet	1510E	1505E			
	24.60	24.60				23.90	23.90			
	0.85	0.85				0.85	0.85			
	3984 142	3790 123				3893 142 > 17	3700 123 > 17			

Items listed in vertical order per riser:

- (1) Partial drawing number - [NN]<sub>ih</sub> [NN]<sub>is</sub> [E]<sub>R</sub>
- (2) Volume of concrete for full height riser, N<sub>ih</sub> equals tabulated value, cu. yds.
- (3) Change in volume of concrete per foot decrease in height of riser, cu. yds.
- (4) Weight of steel for full height riser, N<sub>ih</sub> equals tabulated value, lbs.
- (5) Approximate change in weight of steel per foot decrease in height of riser, lbs.
- (6) Allowable wind projection, see sheet 1 of this drawing, feet.

**REFERENCE**

SCS Engineering Memo. - 50  
SCS Technical Release - 29  
SCS Technical Release - 30

U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE  
ENGINEERING DIVISION - DESIGN UNIT

**STANDARD DWG. NO.**

**ES- 169**

**SHEET 5 OF 7**

**DATE 7-65**

**STANDARD PLANS: STANDARD COVERED RISERS  
SCHEDULE SHOWING DRAWING NUMBERS, VOLUMES  
OF CONCRETE, AND WEIGHTS OF STEEL.**

**PIPE  
CONDUIT  
DIAMETER  
= 42"**

STANDARD DETAIL DRAWINGS, ES-3042-[NN] <sub>ih</sub> [NN] <sub>is</sub> [E] <sub>R</sub>					RISERS TO BE LOCATED IN EMBANKMENT			
$N_{th}$ feet	RISERS TO BE LOCATED IN RESERVOIR AREA				RISERS TO BE LOCATED IN EMBANKMENT			
	$N_{sh} = N_{th} - N_{is}$ , feet							
	5	10	15	20				
40	4035R 90.75 2.27 16919 368	4030R 91.15 2.27 15054 310	4025R 82.85 1.89 17984 378	4020R 80.45 1.89 15145 308	4035E 104.85 2.27 19698 380 33	4030E 97.25 2.27 15782 310 30	4025E 84.65 1.89 16026 378 29	4020E 77.35 1.89 14492 308 26
35	3530R 74.85 1.89 14754 375	3525R 71.55 1.89 12934 308	3520R 73.75 1.89 12942 301	3515R 67.35 1.53 12709 367	3530E 83.45 1.89 15662 375 30	3525E 75.75 1.89 13398 308 25	3520E 72.45 1.89 12723 301 26	3515E 64.25 1.53 12362 367 22
30	3025R 67.85 1.89 11721 301	3020R 59.85 1.53 11071 313	3015R 57.95 1.53 11033 302	3010R 59.35 1.53 10284 251	3025E 72.45 1.89 12200 301 25	3020E 61.25 1.53 11197 313 23	3015E 55.75 1.53 10733 302 19	3010E 55.75 1.53 9691 251 19
25	2520R 52.55 1.53 9509 251	2515R 53.95 1.53 9028 245	2510R 47.80 1.18 8541 257	2505R 43.05 0.97 8463 249	2520E 54.35 1.53 9705 251 22	2515E 52.25 1.53 8840 245 20	2510E 45.70 1.18 8306 257 21	2505E 41.25 0.97 8174 249 21
20	2015R 40.50 1.18 7583 260	2010R 36.45 0.97 7152 240	2005R 36.35 0.97 6702 192	-	2015E 40.50 1.18 7583 260 > 23	2010E 35.85 0.97 7092 240 > 23	2005E 34.65 0.97 6501 192 18	-
	-	-	-	-	-	-	-	-
Items, listed in vertical order per riser: (1) Partial drawing number - [NN] <sub>ih</sub> [NN] <sub>is</sub> [E] <sub>R</sub> (2) Volume of concrete for full height riser, $N_{th}$ equals tabulated value, cu. yds. (3) Change in volume of concrete per foot decrease in height of riser, cu. yds. (4) Weight of steel for full height riser, $N_{th}$ equals tabulated value, lbs. (5) Approximate change in weight of steel per foot decrease in height of riser, lbs. (6) Allowable wind projection, see sheet 1 of this drawing, feet.								

**REFERENCE**

SCS Engineering Memo. - 50  
SCS Technical Release - 29  
SCS Technical Release - 30

**U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE  
ENGINEERING DIVISION - DESIGN UNIT**

**STANDARD DWG. NO.**

**ES- 169**

**SHEET 6 OF 7**

**DATE 9 - 66**

**STANDARD PLANS: STANDARD COVERED RISERS  
SCHEDULE SHOWING DRAWING NUMBERS, VOLUMES  
OF CONCRETE, AND WEIGHTS OF STEEL.**

**PIPE  
CONDUIT  
DIAMETER  
= 48 "**

**STANDARD DETAIL DRAWINGS, ES-3048-[NN]<sub>th</sub>[NN]<sub>is</sub>[E]<sub>R</sub>**

N <sub>th</sub> feet	RISERS TO BE LOCATED IN RESERVOIR AREA				RISERS TO BE LOCATED IN EMBANKMENT			
	N <sub>sh</sub> = N <sub>th</sub> - N <sub>is</sub> , feet				N <sub>sh</sub> = N <sub>th</sub> - N <sub>is</sub> , feet			
	5	10	15	20	5	10	15	20
40	4035R 122.90 2.96 20160 374	4030R 106.35 2.53 20404 428	4025R 106.25 2.53 20018 424	4020R 108.55 2.53 18132 362	4035E 134.80 2.96 22278 374	4030E 114.65 2.53 20878 428	4025E 105.15 2.53 19960 424	4020E 102.35 2.53 17941 362
	3530R 97.75 2.53 17087 362	3525R 99.85 2.53 16846 362	3520R 87.05 2.11 16781 356	3515R 87.85 2.11 15872 356	3530E 105.75 2.53 17975 362	3525E 101.65 2.53 16834 362	3520E 83.95 2.11 16490 356	3515E 83.45 2.11 15415 356
	3025R 78.25 2.11 14438 356	3020R 78.95 2.11 14419 356	3015R 72.35 1.71 13778 347	3010R 71.85 1.71 13618 344	3025E 82.55 2.11 14928 356	3020E 77.95 2.11 14252 356	3015E 68.95 1.71 13461 347	3010E 65.85 1.71 13008 344
	2520R 60.95 1.71 11993 347	2515R 62.05 1.71 12070 344	2510R 56.95 1.33 11091 301	2505R 57.05 1.33 10984 298	2520E 63.25 1.71 12293 347	2515E 60.35 1.71 11873 344	2510E 54.15 1.33 10779 301	2505E 51.55 1.33 9857 298
20	2015R 49.95 1.33 9599 301	2010R 48.05 1.33 9278 295	2005R 44.25 1.09 9027 278	-	2015E 49.95 1.33 9599 301	2010E 46.95 1.33 9131 295	2005E 42.65 1.09 8795 278	-
	-	-	-	-	-	-	-	-

Items listed in vertical order per riser:

- (1) Partial drawing number - [NN]<sub>th</sub>[NN]<sub>is</sub>[E]<sub>R</sub>
- (2) Volume of concrete for full height riser, N<sub>th</sub> equals tabulated value, cu. yds.
- (3) Change in volume of concrete per foot decrease in height of riser, cu. yds.
- (4) Weight of steel for full height riser, N<sub>th</sub> equals tabulated value, lbs.
- (5) Approximate change in weight of steel per foot decrease in height of riser, lbs.
- (6) Allowable wind projection, see sheet 1 of this drawing, feet.

REFERENCE	U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE ENGINEERING DIVISION - DESIGN UNIT	STANDARD DWG. NO. ES- 169 SHEET 7 OF 7 DATE 2 - 69
SCS Engineering Memo. - 50 SCS Technical Release - 29 SCS Technical Release - 30		



# STANDARD PLANS: STANDARD OPEN RISERS SELECTION OF STANDARD DETAIL DRAWINGS

## Key to Drawing Numbers

The drawing numbers of the Standard Detail Drawings for Standard Open Risers are given by:

ES-31DD-[NN]<sub>th</sub>[NN]<sub>is</sub>[<sup>E</sup><sub>R</sub>]

where

DD = D = pipe conduit diameter, inches.

[NN]<sub>th</sub> = N<sub>th</sub> = vertical distance from pipe invert at the riser to crest of the Open Riser Inlet, ft.

[NN]<sub>is</sub> = N<sub>is</sub> = vertical distance from pipe invert at the riser to soil surface, ft. The soil surface is either the sediment or the embankment (berm) surface.

[<sup>E</sup><sub>R</sub>] = riser is designed to be located in the [embankment reservoir area].

## Standard Detail Drawings

Each set of Standard Detail Drawings for a Standard Open Riser consists of four sheets. The Open Riser Inlet is shown on sheet 4.

The Standard Open Risers tabulated on sheet 2 of this drawing are designed for N<sub>th</sub> = N<sub>is</sub>.

A set of Standard Detail Drawings may be adapted to a range of riser heights. The height may vary from the full design height given by N<sub>th</sub> in the drawing number to five feet less than N<sub>th</sub>. The only exception to the preceding statement occurs with risers having D = 36 in. and N<sub>th</sub> = 10 ft, for which the height range is four feet.

## Selection of Standard Detail Drawings

The set of Standard Detail Drawings to be selected is that having the smallest N<sub>th</sub> which is greater than or equal to the N<sub>th</sub> desired at the specific site.

## Adaptation of Standard Detail Drawings

After the Standard Detail Drawings have been selected, they must be adapted to the desired riser height. The adaptation is accomplished by completing the fill-ins on sheets 1 and 3 of the drawings. The value to be inserted in a fill-in is either a vertical dimension, a reinforcement bar length, a reinforcement bar quantity, a reinforcement bar weight, or a concrete volume.

## Volumes and Weights of Materials

Quantities for Standard Open Risers are given on sheet 2 of this drawing.

## Wind Projections

Risers to be located in the embankment are not designed for wind load. An allowable wind projection is tabulated for these risers on sheet 2. The tabulated allowable wind projection was computed for the conditions:

- (1) No embankment is placed in the vicinity of the riser.
- (2) Moist soil condition, allowable earth bearing pressures are:

$$P_{max} \leq 4 \text{ ksf}$$

$$P_{av} \leq 2 \text{ ksf}$$

$$P_{min} \geq 0 \text{ ksf}$$

- (3) Wind load on the sidewall is 50 psf.
- (4) The constructed riser height, above the top of the footing, does not exceed the allowable wind projection.

The assumption is made that the allowable wind projection for other conditions of embankment placement and riser height is not less than that tabulated. Thus, the tabulated allowable wind projection may be considered as the allowable vertical distance between the surface of the embankment and the top of the riser at any stage of construction.

## REFERENCE

SCS Engineering Memo. - 50

U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE  
ENGINEERING DIVISION - DESIGN UNIT

## STANDARD DWG. NO.

ES-180

SHEET 1 OF 2

DATE 3-68

## STANDARD PLANS: STANDARD OPEN RISERS

SCHEDULE SHOWING DRAWING NUMBERS, VOLUMES OF CONCRETE,  
AND WEIGHTS OF STEEL.

STANDARD DETAIL DRAWINGS, ES-3124-[NN] <sub>th</sub> , [NN] <sub>is</sub> [ $\frac{E}{R}$ ]											
$N_{th} = N_{is}$	ES-3124-		ES-3130-		ES-3136-		ES-3142-		ES-3148-		
	R	E	R	E	R	E	R	E	R	E	
3535	35.55 0.97	51.55 0.97	43.94 1.16	61.16 1.16	60.25 1.67	76.90 1.67	80.05 2.27	92.83 2.27	108.50 2.96	118.90 2.96	
	7038 187	10189 213	9270 276	12500 303	11999 338	14608 360	15210 368	17484 380	18092 374	19886 374	
	-	25	-	27	-	30	-	33	-	34	
	27.70 0.74	36.19 0.74	36.50 1.16	43.70 1.16	52.15 1.67	61.93 1.67	64.85 1.89	71.45 1.89	83.35 2.53	89.85 2.53	
3030	6024 206	7219 218	7413 232	8743 232	9454 269	10626 269	13045 375	13444 375	15019 362	15583 362	
	-	19	-	20	-	26	-	30	-	31	
	23.40 0.74	26.20 0.74	28.80 0.89	31.88 0.89	41.75 1.35	45.14 1.35	55.85 1.89	59.23 1.89	63.85 2.11	66.65 2.11	
	4511 167	5011 167	5986 240	6414 240	7662 263	8113 263	9929 301	10226 301	12370 356	12536 356	
2525	-	15	-	21	-	22	-	25	-	26	
	17.00 0.60	18.90 0.60	22.48 0.89	23.62 0.89	30.60 1.04	31.20 1.04	40.41 1.53	41.22 1.53	46.55 1.71	47.35 1.71	
	3487 154	3607 154	4387 162	4539 162	5951 227	6054 227	7792 251	7806 251	9925 347	9901 347	
	-	11	-	14	-	17	-	22	-	>25	
1515	12.70 0.60	12.65 0.60	15.45 0.72	15.73 0.72	21.92 0.85	21.08 0.85	28.50 1.18	27.36 1.18	35.55 1.33	34.05 1.33	
	2288 116	2215 116	3242 148	3316 148	4539 185	4450 185	5865 260	5684 260	7531 301	7207 301	
	-	9	-	13	-	12	-	> 19	-	>20	
	9.32 0.60	8.76 0.60	11.01 0.72	10.84 0.72	15.50 0.85	14.36 0.85	-	-	-	-	
1010	1446 84	1382 84	1966 111	1924 111	2695 142	2566 142	-	-	-	-	
	-	> 12	-	> 13	-	> 13	-	-	-	-	

Items, listed in vertical order per riser:

- (1) Volume of concrete for full height riser,  $N_{th} = N_{is}$ , cu. yds.
- (2) Change in volume of concrete per foot decrease in height of riser, cu. yds.
- (3) Weight of steel for full height riser,  $N_{th} = N_{is}$ , lbs.
- (4) Approximate change in weight of steel per foot decrease in height of riser, lbs.
- (5) Allowable wind projection, ft. (see sheet 1 of this drawing)

REFERENCE	U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE ENGINEERING DIVISION - DESIGN UNIT	STANDARD DWG. NO. ES - 180 SHEET <u>2</u> OF <u>2</u> DATE <u>3-68</u>
SCS Engineering Memo. - 50		

**STANDARD PLANS: STANDARD IMPACT BASINS  
SCHEDULE SHOWING DRAWING NUMBERS, VOLUMES  
OF CONCRETE, AND WEIGHTS OF STEEL.**

STANDARD DETAIL DRAWINGS ES-4WWW	QUANTITIES*	
	STEEL - lbs.	CONCRETE - cu. yds.
ES-4050	1500	10
-4060	1900	12.5
-4070	2200	15
-4080	2800	20
-4090	3300	23
-4100	3900	28
-4110	4800	33
-4120	5700	38
-4130	6700	43.5
-4135	7300	46.5
-4140	7900	50.5
-4145	8800	55
-4150	10,000	58.5
-4155	10,600	62
-4160	11,000	65
-4165	12,400	70
-4170	13,300	73.5
-4175	14,100	77

Key to Drawing Numbers

The drawing numbers of the Standard Detail Drawings for Standard Impact Basins are given by:

ES-4WWW

where

WWW ≡ width of basin, WW.W ft

\*Quantities of steel and concrete tabulated were obtained from sheet 1 of each ES-drawing. These quantities are approximate since quantities vary with pipe diameter.

REFERENCE	U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE ENGINEERING DIVISION - DESIGN UNIT	STANDARD DWG. NO. ES- 186 SHEET <u>1</u> OF <u>1</u> DATE <u>5 - 70</u>



# STANDARD PLANS: STANDARD CONDUIT DETAILS

## SCHEDULE SHOWING DRAWING NUMBERS

AVAILABLE STANDARD DETAIL DRAWINGS  
FOR  
REINFORCED CONCRETE PRESSURE PIPE  
PRINCIPAL SPILLWAYS

Class (a) dams more than 50 ft. high, and all class (b) and class (c) dams		Alternate for class (a) dams less than 50 ft. high	
ES-5018-CE	ES-5036-CE	ES-5118-CE	ES-5136-CE
-CR	-CR	-CR	-CR
-BE	-BE	-BE	-BE
-BR	-BR	-BR	-BR
ES-5024-CE	ES-5042-CE	ES-5124-CE	ES-5142-CE
-CR	-CR	-CR	-CR
-BE	-BE	-BE	-BE
-BR	-BR	-BR	-BR
ES-5030-CE	ES-5048-CE	ES-5130-CE	ES-5148-CE
-CR	-CR	-CR	-CR
-BE	-BE	-BE	-BE
-BR	-BR	-BR	-BR

### Key to Drawing Numbers

The drawing numbers of the Standard Detail Drawings for Standard Conduit Details are given by:

$$ES-5[1]^0 DD-[C_B][E_R]$$

where

$DD \equiv D$  = pipe conduit diameter, inches

$[C_B] \equiv$  pipe is supported on cradles or beddings

$[E_R] \equiv$  foundation is earth (yielding) or rock (non-yielding)

### Completion of Standard Detail Drawings

Various items must be filled in to complete the drawings for inclusion in a set of construction plans. These are: the pipe strength requirements, the pipe joint requirements, the steel schedule, and material quantities. Relations are given from which the volumes of concrete may be obtained.

REFERENCE	U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE ENGINEERING DIVISION - DESIGN UNIT	STANDARD DWG. NO. ES- 195 SHEET <u>1</u> OF <u>1</u> DATE <u>10-70</u>
SCS Engineering Drawing, ES-154		



# STANDARD PLANS: STANDARD BAFFLE RISERS SELECTION OF STANDARD DETAIL DRAWINGS

## Key to Drawing Numbers

The drawing numbers of the Standard Detail Drawings for Standard Baffle Risers are given by:

ES-32DD-[NN]<sub>ih</sub>[NN]<sub>is</sub>[E]<sub>R</sub>

where

DD     ≡ D     = pipe conduit diameter, inches

[NN]<sub>ih</sub>     ≡ N<sub>ih</sub>     = vertical distance from pipe invert at the riser to crest of the Baffle Riser Inlet, ft.

[NN]<sub>is</sub>     ≡ N<sub>is</sub>     = vertical distance from pipe invert at the riser to soil surface, ft. The soil surface is either the sediment or the embankment (berm) surface.

[E]     ≡     riser is designed to be located in the [embankment reservoir area].

## Standard Detail Drawings

Each set of Standard Detail Drawings for a Standard Baffle Riser consists of four sheets. The Baffle Riser Inlet is shown on sheet 4.

The Standard Baffle Risers tabulated on sheet 2 of this drawing are designed for N<sub>ih</sub> = N<sub>is</sub>.

A set of Standard Detail Drawings may be adapted to a range of riser heights. The height may vary from the full design height given by N<sub>ih</sub> in the drawing number to five feet less than N<sub>ih</sub>. The only exception to the preceding statement occurs with risers having D = 36 in. and N<sub>ih</sub> = 10 ft, for which the height range is four feet.

## Selection of Standard Detail Drawings

The set of Standard Detail Drawings to be selected is that having the smallest N<sub>ih</sub> which is greater than or equal to the N<sub>ih</sub> desired at the specific site.

## Adaptation of Standard Detail Drawings

After the Standard Detail Drawings have been selected, they must be adapted to the desired riser height. The adaptation is accomplished by completing the fill-ins on sheets 1 and 3 of the drawings. The value to be inserted in a fill-in is either a vertical dimension, a reinforcement bar length, a reinforcement bar quantity, a reinforcement bar weight, or a concrete volume.

## Volumes and Weights of Materials

Quantities for Standard Baffle Risers are given on sheet 2 of this drawing.

## Wind Projections

Risers to be located in the embankment are not designed for wind load. An allowable wind projection is tabulated for these risers on sheet 2. The tabulated allowable wind projection was computed for the conditions:

- (1) No embankment is placed in the vicinity of the riser.
- (2) Moist soil condition, allowable earth bearing pressures are:  
 $P_{max} \leq 4 \text{ ksf}$   
 $P_{av} \leq 2 \text{ ksf}$   
 $P_{min} \geq 0 \text{ ksf}$
- (3) Wind load on the sidewall is 50 psf.
- (4) The constructed riser height, above the top of the footing, does not exceed the allowable wind projection.

The assumption is made that the allowable wind projection for other conditions of embankment placement and riser height is not less than that tabulated. Thus, the tabulated allowable wind projection may be considered as the allowable vertical distance between the surface of the embankment and the top of the riser at any stage of construction.

REFERENCE	U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE ENGINEERING DIVISION - DESIGN UNIT	STANDARD DWG. NO. ES-231 SHEET <u>1</u> OF <u>2</u> DATE <u>3-80</u>
National Engineering Manual Part 536		

# STANDARD PLANS: STANDARD BAFFLE RISERS

## SCHEDULE SHOWING DRAWING NUMBERS, VOLUMES OF CONCRETE, AND WEIGHTS OF STEEL.

STANDARD DETAIL DRAWINGS, ES-32DD-[NN] <sub>ih</sub> [NN] <sub>is</sub> <sup>E</sup>										
$N_{ih} = N_{is}$	ES-3224-		ES-3230-		ES-3236-		ES-3242-		ES-3248-	
	R	E	R	E	R	E	R	E	R	E
3535	38.55 0.97	54.65 0.97	47.90 1.16	65.30 1.16	66.85 1.67	83.95 1.67	87.05 2.27	101.15 2.27	117.00 2.96	128.90 2.96
	7483 187	10674 213	9849 276	13123 303	12974 338	15622 360	15887 368	18667 380	19225 374	21342 374
	— —	25	— —	27	— —	30	— —	33	— —	34
3030	30.70 0.74	39.50 0.74	40.50 1.16	47.90 1.16	58.65 1.67	68.95 1.67	71.15 1.89	79.75 1.89	91.85 2.53	99.85 2.53
	6470 206	7701 218	7992 232	9368 232	10449 269	11624 269	13725 375	14633 375	16153 362	17041 362
	— —	19	— —	20	— —	26	— —	30	— —	31
2525	26.30 0.74	29.50 0.74	32.75 0.89	36.05 0.89	48.05 1.35	52.25 1.35	63.15 1.89	67.75 1.89	72.35 2.11	76.65 2.11
	4973 167	5498 167	6567 240	7039 240	8653 263	9078 263	10863 301	11342 301	13503 356	13993 356
	— —	15	— —	21	— —	22	— —	25	— —	26
2020	20.00 0.60	22.00 0.60	26.45 0.89	27.75 0.89	37.20 1.04	38.20 1.04	47.85 1.53	49.65 1.53	55.05 1.71	57.35 1.71
	3934 154	4090 154	4973 162	5168 162	6942 227	7052 227	8726 251	8921 251	11057 347	11357 347
	— —	11	— —	14	— —	17	— —	22	— —	>25
1515	15.70 0.60	15.80 0.60	19.50 0.72	19.90 0.72	28.55 0.85	28.05 0.85	35.80 1.18	35.80 1.18	44.05 1.33	44.05 1.33
	2735 116	2619 116	4172 148	3852 148	5522 185	5470 185	6799 260	6799 260	8664 301	8664 301
	— —	9	— —	13	— —	12	— —	>20	— —	>20
1010	12.20 0.60	11.90 0.60	15.00 0.72	15.00 0.72	22.10 0.85	21.40 0.85	— —	— —	— —	— —
	1909 84	1909 84	2553 111	2553 111	3677 142	3587 142	— —	— —	— —	— —
	— —	>13	— —	>14	— —	>14	— —	— —	— —	— —

Items, listed in vertical order per riser:

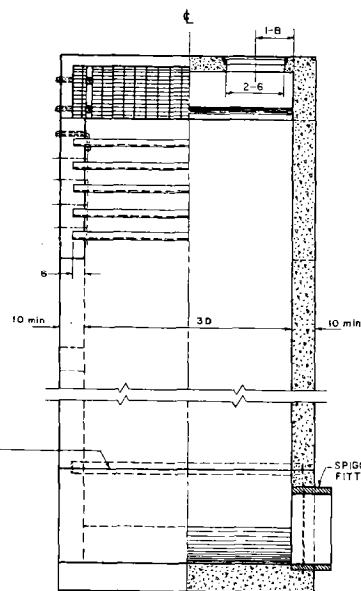
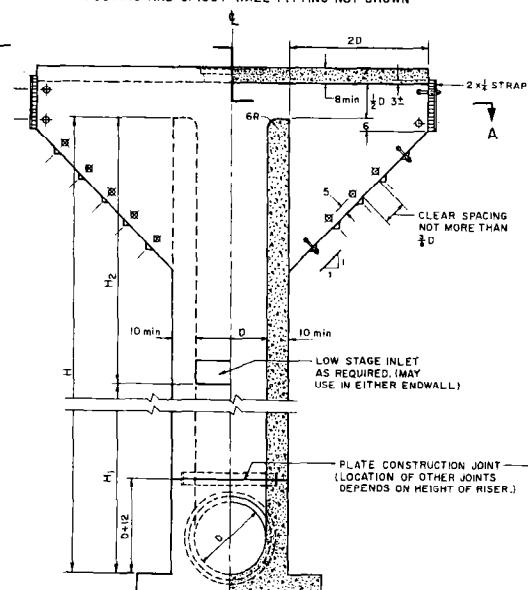
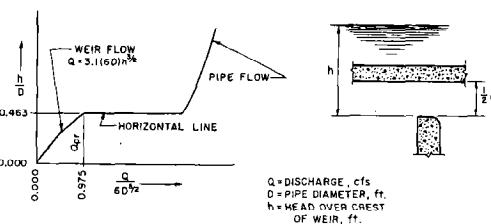
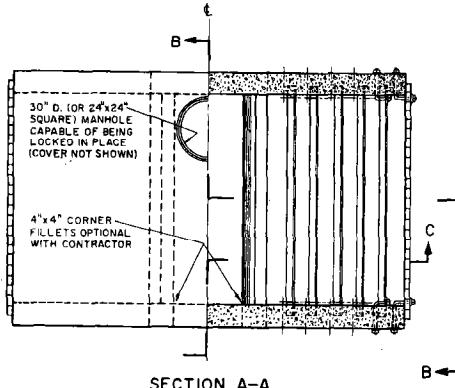
- (1) Volume of concrete for full height riser,  $N_{ih} = N_{is}$ , cu. yds.
- (2) Change in volume of concrete per foot decrease in height of riser, cu. yds.
- (3) Weight of steel for full height riser,  $N_{ih} = N_{is}$ , lbs.
- (4) Approximate change in weight of steel per foot decrease in height of riser, lbs.
- (5) Allowable wind projection, ft. (see sheet 1 of this drawing).

### REFERENCE

National Engineering Manual  
Part 536

U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE  
ENGINEERING DIVISION - DESIGN UNIT

STANDARD DWG. NO.  
ES-231  
SHEET 2 OF 2  
DATE 3-80



#### SCOPE

1. The covered top riser is a standard for two-stage risers, and also for single-stage risers in multi-purpose sites if the maximum sediment elevation is set at least  $(20+12)$  feet above the crest.

#### 2. Height Ranges of Riser:

High stage,  $H_2 = (20+6)$  to 20 feet  
Low stage,  $H_1 = D$  to 30 feet  
Sum,  $H = H_2 + H_1 \leq 40$  feet.

#### CRITERIA

##### 1. Pipe Diameters and Associated Discharges:

D	$Q_{pr} = 0.975(D^0.75)$	$Q_{max} = \frac{30}{4}D^2$
24	33	94
30	58	148
36	92	212
42	135	288
48	188	376

Note:  
Maximum allowable nominal velocity in pipe = 30 fpm.

##### 2. Hydraulic Losses (pipe flow):

Head loss between pool water surface and the projected hydraulic grade line of the pipe entrance = 1.0 times the velocity head in the pipe.

##### 3. Trashrocks:

Required net area for National Standard Detailed Drawings to be computed from  $\Delta_{min}$  or listed Criteria 11, and an allowable average velocity of 2.0 fpm.  
All bolts, nuts, pipe sleeves, and grating, to be galvanized or otherwise protected by corrosion resistant coating except when made of aluminum.

##### 4. Cover slab live load = 100 psf plus weight of any equipment on the slab.

##### 5. Flotation:

When riser is in reservoir - the ratio of the weight of riser to the weight of the volume of water displaced by the riser shall not be less than 1.5.  
When riser is in the embankment - add to the weight of the riser, the buoyant weight of submerged fill over footing projections.

##### 6. Dry Dams:

Where sediment is not a problem - set crest of low stage inlet at required elevation.  
Where sediment is a problem - use a series of slotted openings up the longitudinal sides. Trashrocks are not required for these openings.

##### 7. Materials:

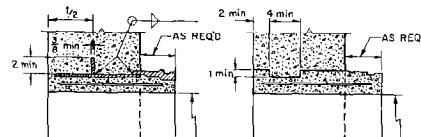
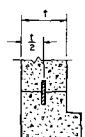
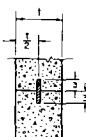
Concrete: Class B,  $f_c = 4000$  psi,  $f_t = 1600$  psi.

Reinforcing Steel: Intermediate grade.

Trashrock: Structural steel or structural aluminum.

#### NOTES

- Riser Analyses: Standards to be developed for risers located in the embankment (at berm) and for risers located in reservoir area.
- Round Bottom: May be obtained by use of a pipe cut longitudinally along a diameter, or may be formed by removable semi-circular forms acceptable to the engineer.
- Drainage of Pool: Provision of means of draining pool to be handled as a modification of these standards by the Field.

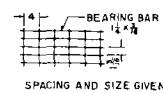
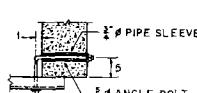


1 MIN X 5 STEEL PLATE TO BE  
CONTINUOUS AROUND RISER, TO BE  
EITHER BUTT WELDED, LAPPED  
AND FILLET WELDED, OR LAPPED  
AND BOLTED AT ALL JOINTS (SPLICES).

SPIGOT WALL FITTING FOR PIPE  
AS DESIGNED AND MANUFACTURED  
UNDER A.W.A. SPECIFICATION  
C-300, C-301 AND C-302, AND  
A.S.T.M. DESIGNATION C-361.

SPIGOT WALL FITTING FOR PIPE  
AS DESIGNED AND MANUFACTURED  
UNDER A.W.A. SPECIFICATION  
C-302 AND A.S.T.M. DESIGNATION  
C-361.

#### PLATE CONSTRUCTION JOINT DETAIL



SPACING AND SIZE GIVEN  
ARE MINIMUMS

#### BOLT DETAIL

GRATING DETAIL-STEEL OR  
ALUMINUM.

#### DROP INLET SPILLWAYS STANDARD FOR COVERED TOP RISER

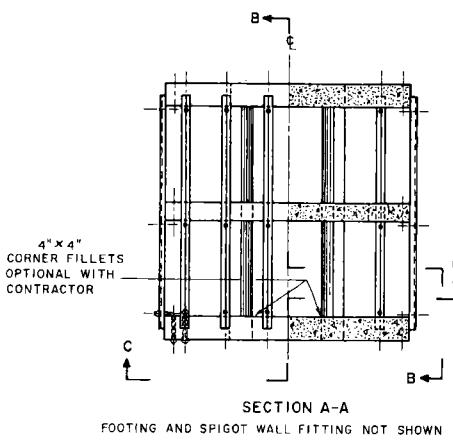
U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

DESIGNED BY	ENGINEERING DIV.	DATE	APPROVED BY
DRAWN BY		6-63	Title _____
STANDARD DWG. NO.			
PATL			

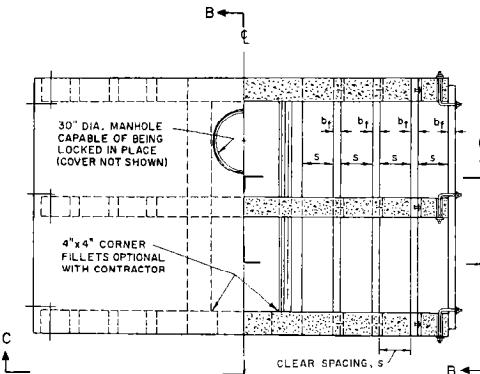
ENGINEERING DIVISION - DESIGN SECTION	
ENGINEERING APPROVAL	CARTOGRAPHIC APPROVAL
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CHECKED BY	STANDARD DWG. NO.
PATL	SUPER

LOW STAGE INLET DETAILS TO BE HANDLED AS A MODIFICATION OF  
THESE STANDARDS BY THE FIELD



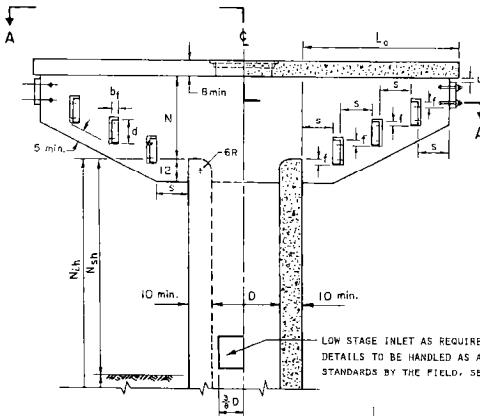






SECTION A-A

FOOTING AND SPIGOT WALL FITTING NOT SHOWN



## SCOPE

1. THE BAFFLE TOP RISER IS A STANDARD FOR ONE AND TWO-STAGE RISERS.
2. HEIGHT RANGES OF RISER:  
 $N_{hs} \leq 20$  FT.  
 $N_{ls} \leq 35$  FT.  
 $N_{rh} \leq 40$  FT.

## CRITERIA

1. PIPE DIAMETERS AND ASSOCIATED DISCHARGES:

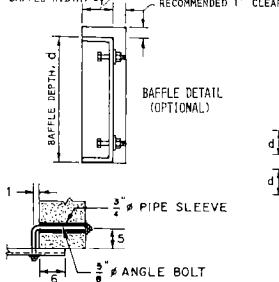
D	$D_{MAX} = \frac{20}{4} \pi D^2$
24	94
30	147
36	212
42	289
48	377

2. HYDRAULICS:

THE WEIR DISCHARGE COEFFICIENT, C:

 $C = 3.1$  (CLEAR WATER FLOW) $C = 2.0$  (TRASH LAIDEN FLOW)FOR  $D \times 30$  RISERS WITH ROUND BOTTOMS, THE ENTRANCE HEAD LOSS COEFFICIENT,  $K_e$ : $K_e = 0.60$  (CLEAR WATER FLOW) $K_e = 0.65$  (TRASH LAIDEN FLOW)DURING PIPE FLOW, THE HEAD LOSS BETWEEN POOL WATER SURFACE AND THE PROJECTED HYDRAULIC GRADE LINE AT THE PIPE ENTRANCE =  $K_e$  TIMES THE VELOCITY HEAD IN THE PIPE.

NOTE:  
MAXIMUM ALLOWABLE NOMINAL  
VELOCITY IN PIPE = 30 FPS

BAFFLE WIDTH,  $b_f$  - RECOMMENDED 1" CLEAR

BOLT DETAIL

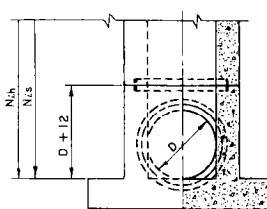
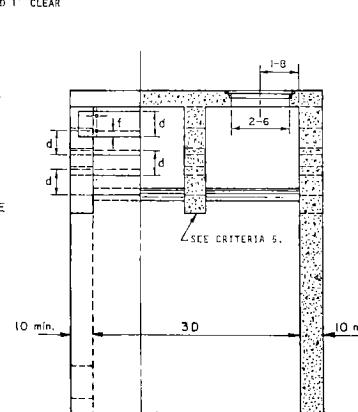
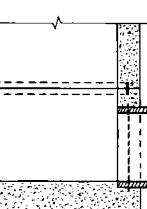
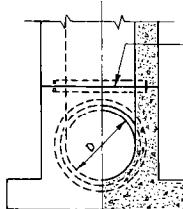


PLATE CONSTRUCTION  
JOINT, FOR DETAIL  
SEE ES-150. LOC-  
ATION OF OTHER JOINTS  
DEPENDS ON HEIGHT  
OF RISER.



## 3. BAFFLES:

REQUIRED NET AREA FOR NATIONAL STANDARD DETAILED DRAWINGS - TO BE COMPUTED FROM  
 $G_{MAX}$  AS LISTED IN CRITERIA (1) AND AN ALLOWABLE AVERAGE VELOCITY OF 2.5 FPS.  
THE CLEAR HORIZONTAL DISTANCE BETWEEN BAFFLES, S:

$$\frac{D}{2} \leq s \leq D$$

THE VERTICAL OVERLAP BETWEEN BAFFLES, f:

$$f \geq 3"$$

THE CLEARANCE BETWEEN THE COVER SLAB AND THE TOP-MOST BAFFLE, U:  
 $2" \leq u \leq 3"$ 
ALL BOLTS, NUTS, AND PIPE SLEEVES TO BE GALVANIZED OR OTHERWISE PROTECTED BY  
CORROSION RESISTANT COATING EXCEPT WHEN MADE OF ALUMINUM.

## 4. COVER SLAB:

COVER SLAB LIVE LOAD = 300 PSF PLUS WEIGHT OF EQUIPMENT ON THE SLAB,  
 $L_o = B(s + b_f)$ , ROUNDED UP TO NEXT INCH  
 $B =$  NUMBER OF BAFFLES ON ONE SIDE OF INLET

THE DISTANCE BETWEEN THE WEIR CREST AND THE UNDERSIDE OF THE COVER SLAB, N, IS  
EQUAL TO OR GREATER THAN THE HEAD OVER THE CREST AT WHICH THE CONDUIT PRIMES  
AND  $C = 2.0$ 

## 5. ANTI-VORTEX WALLS:

OMIT CENTER ANTI-VORTEX WALL WHEN  $D < 36"$ .

## 6. FLOTATION:

WHEN RISER IS IN RESERVOIR - THE RATIO OF THE WEIGHT OF RISER TO THE WEIGHT  
OF THE VOLUME OF WATER DISPLACED BY THE RISER SHALL NOT BE LESS THAN 1.5.  
WHEN RISER IS IN EMBANKMENT - SAME AS ABOVE, BUT ADD TO THE WEIGHT OF THE  
RISER, THE BUOYANT WEIGHT OF THE SUBMERGED FILL OVER THE FOOTING PROJECTIONS.

## 7. DRY DAMS:

WHEN SEDIMENT IS NOT A PROBLEM - SET CREST OF SINGLE STAGE RISER, OR CREST  
OF LOW STAGE INLET OF TWO-STAGE RISER, AT REQUIRED ELEVATION.  
WHERE SEDIMENT IS A PROBLEM - USE A SERIES OF SLOTTED OPENINGS UP THE LONGI-  
TUDINAL SIDES (SEE ES-151). TRASHRACKS ARE NOT REQUIRED FOR THESE OPENINGS.

## 8. MATERIALS:

CONCRETE : CLASS 4000,  $f_c = 1600$  psi.

REINFORCING STEEL : GRADE 40

BAFFLE : AMERICAN STANDARD CHANNELS, MISCELLANEOUS CHANNELS, STRUC-  
TURAL STEEL TUBING OR REINFORCED CONCRETE BEAMS.

## NOTES:

1. RISER ANALYSES:  
STANDARDS TO BE DEVELOPED FOR RISERS LOCATED IN THE EMBANKMENT  
(AT BERM) AND FOR RISERS LOCATED IN THE RESERVOIR AREA.

2. ROUND BOTTOM:  
MAY BE OBTAINED BY USE OF REMOVABLE SEMI-CIRCULAR FORMS AC-  
CEPTABLE TO THE ENGINEER.

3. DRAINAGE OF POOL:  
PROVIDING FOR MEANS OF DRAINING POOL TO BE HANDLED AS A MODI-  
FICATION OF THESE STANDARDS BY THE FIELD.

SPIGOT WALL FITTING, FOR  
DETAIL SEE ES-150

DROP INLET SPILLWAYS  
STANDARD FOR  
BAFFLE TOP RISER

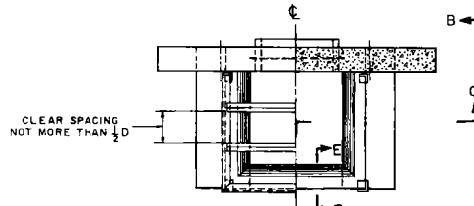
U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	
Design No. <b>3-81</b>	Approved by _____
Drawn by <b>H.J.G.</b>	Date <b>3-81</b>

SECTION C-C

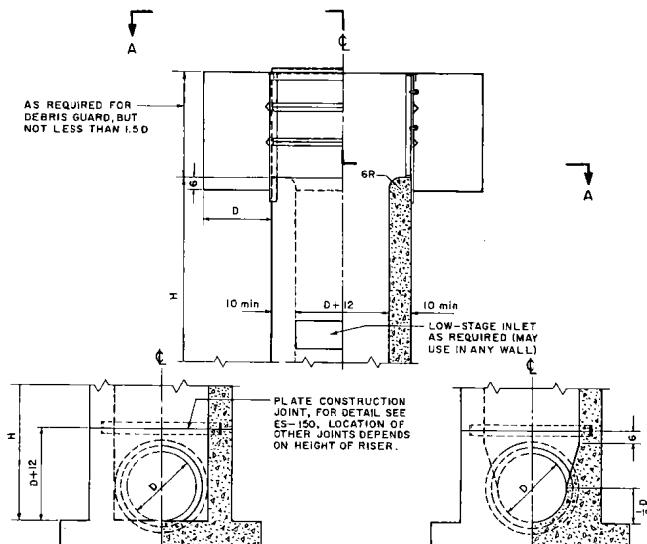
OPENING IN UPSTREAM CHANNEL NEAR BASE OF RISER TO BE HANDLED AS A

SECTION B-B





SECTION A-A



SECTION C-C

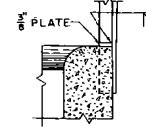
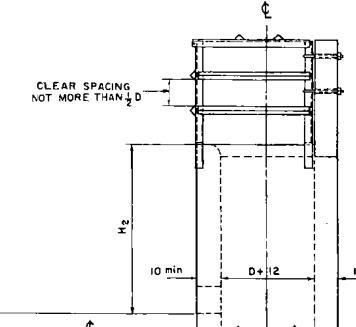
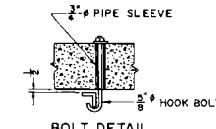
#### SCOPE

- The square open top riser is a standard for one and two-stage risers.
- Height Ranges of Riser:**  
High stage:  $H_2 \leq$  up to 20 feet. (If one-stage riser,  $H \leq 40$  feet.)  
Low stage:  $H_1 \leq$  up to 30 feet.  
Sum:  $H+H_2+H_1 \leq 40$

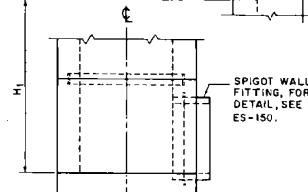
#### CRITERIA

- Pipe Diameters and Associated Discharges:**

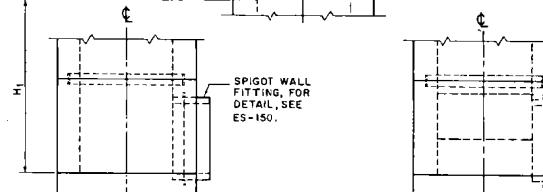
D	$Q_{max} = 30 \pi D^2$	Note:
24	94	Maximum allowable nominal
30	148	velocity in pipe = 30 f.p.s.
36	212	
42	288	
48	376	
- Trashracks:**  
Fabrication—welded or bolted.  
Required net area for National Standard Detailed Drawings—to be computed from  $C_D \times \text{Nominal Area}$ . Criterion: nominal allowable average velocity of 2.0 f.p.s. All bolted or pipe sleeves and gratings galvanized or otherwise protected by corrosion-resistant coating except when made of aluminum. Grating may be used at weir crest level (but not for more than 3' above crest). Required net area is exclusive of any grated area.
- Flootation:**  
When riser is in reservoir—the ratio of the weight of riser to the weight of the volume of water displaced by the riser shall not be less than 1.5. When the riser is in embankment—add to the weight of the riser, the buoyant weight of the submerged fill over the footing projections.



SECTION E-E



SECTION B-B



#### DROP INLET SPILLWAYS STANDARD FOR SQUARE OPEN TOP RISER

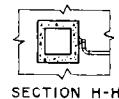
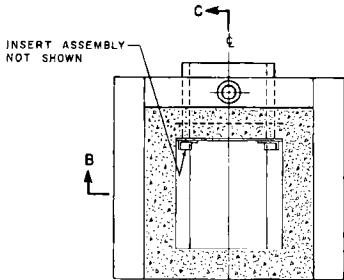
U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

ENGINEERING DIVISION - DESIGN SECTION	
ENGINEERING APPROVAL	CARTOGRAPHIC APPROVAL
DESIGNED BY	DRAWN BY
CHECKED BY	STANDARD DRAWING NO.

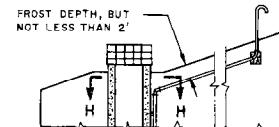
LOW STAGE INLET DETAIL TO BE HANDLED AS A  
MODIFICATION OF THESE STANDARDS BY THE FIELD.

Designed... ENGINEERING DIVISION	Date	Approved by
Drawn... F.S.A.	Date	Title
Checked... S.B.G.	Date	Title
Traced... S.B.G.	Date	Title

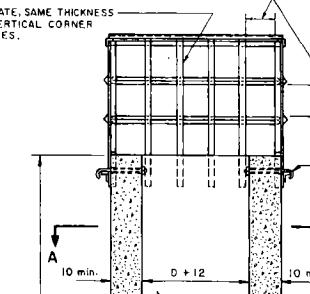
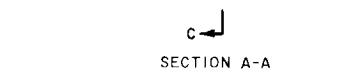




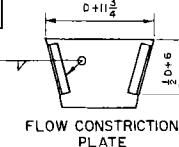
SECTION H-H



ALTERNATE VENT LAYOUT



SECTION B-B  
VENT PIPE NOT SHOWN



FLOW CONSTRICION PLATE

BEND OPTIONAL, IF USED  
FABRICATE FROM ELBOW

ELEVATION OF CREST OF  
EMERGENCY SPILLWAY

SCREENED OPENING

STEEL VENT PIPE,  
DIAMETER  $\geq 4"$

CLEAR SPACING NOT MORE  
THAN THE SMALLER OF  
 $\frac{3}{4}d$  OR  $\frac{1}{2}D$ .

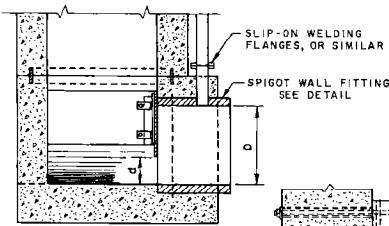
$\frac{5}{8}$ "  $\phi$  HOOK BOLTS AND  
 $\frac{3}{4}$ "  $\phi$  PIPE SLEEVES

A 10 min. D + 12 A 10 min.

A 10 min. D + 12 A 10 min.

A 10 min. D + 12 A 10 min.

PLATE CONSTRUCTION JOINT;  
FOR DETAIL SEE ES-150.  
LOCATION OF OTHER JOINTS  
DEPENDS ON HEIGHT OF RISER.



SECTION C-C

#### SCOPE

1. Pipe Diameters:  $D = 24"$  or  $30"$
2. Maximum Height ( $H$ ) = 40ft.

#### CRITERIA

1. Discharge:

$$Q = 0.67a \sqrt{2gh} \quad \text{Where the area } (a) \text{ may be found from ES-97, sheet 1 of 7,}$$

and the head ( $h$ ) is measured from the centroid of the area.

2. Trashrock:

Fabrication - welded or bolted.

Required Net Area for National Standard Detailed Drawings - to be computed from  $Q_{max}$  and an allowable average velocity of 2.0 f.p.s.  
All bolts, nuts, and pipe sleeves, to be galvanized or otherwise protected by corrosion resistant coating except when made of aluminum.

3. Flotation:

When riser is in reservoir - the ratio of the weight of the riser to the weight of volume of water displaced by the riser shall not be less than 1.5.

When riser is in embankment - add to the weight of the riser, the buoyant weight of the submerged fill over the footing projections.

4. Materials:

Concrete: Class B,  $f_c = 4000$  psi,  $f_c = 1600$  psi.

Reinforcing Steel: Intermediate grade.

Trashrock: Structural Steel or structural aluminum.

#### NOTES:

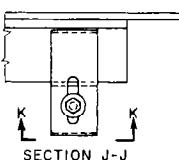
1. Riser Analyses:

Standards to be developed for risers located in the embankment (at berm) and for risers located in the reservoir area.

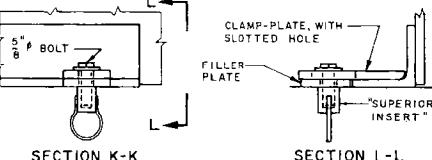
2. Round Bottom: May be obtained by use of a pipe cut longitudinally along a diameter, or may be formed by removable semi-circular forms acceptable to the engineer.

3. Drainage of Pool:

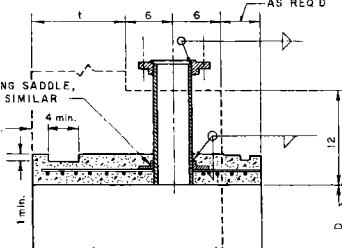
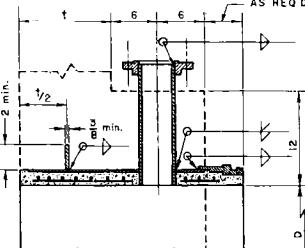
Provision of means of draining pool to be handled as a modification of these standards by the Field.



SECTION J-J  
CONSTRUCTION PLATE CONNECTION DETAIL



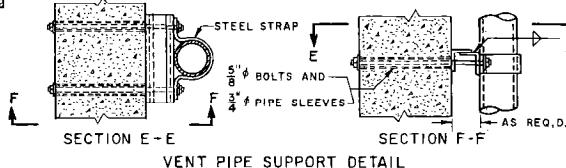
SECTION L-L



FOR PIPE AS DESIGNED AND MANUFACTURED  
UNDER A.W.W.A. SPECIFICATIONS C-300,  
C-301, AND C-302, AND A.S.T.M.  
DESIGNATION C-361.

FOR PIPE AS DESIGNED AND MANUFACTURED  
UNDER A.W.W.A. SPECIFICATION C-302 AND  
A.S.T.M. DESIGNATION C-361.

VENTED SPIGOT WALL FITTING DETAIL



SECTION E-E  
VENT PIPE SUPPORT DETAIL

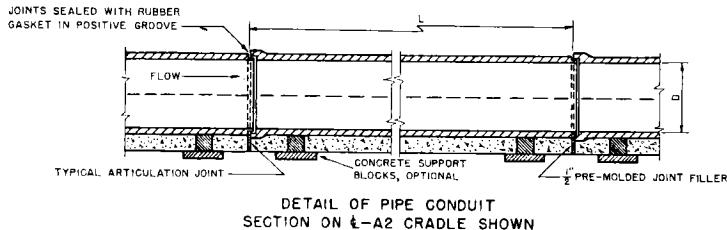
#### DROP INLET SPILLWAYS STANDARD FOR RESTRICTED FLOW RISER

U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

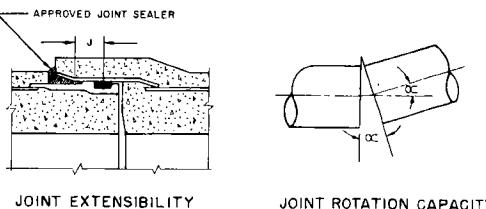
Engineering Approval	Cartographic Approval	Date	Approved by
Designated Engineering Div.			
Drawn, F.S.A.		1-63	
Traced, I.C.G.		2-63	

Engineering Approval	Cartographic Approval
Designated	
Drawn, I.C.G.	





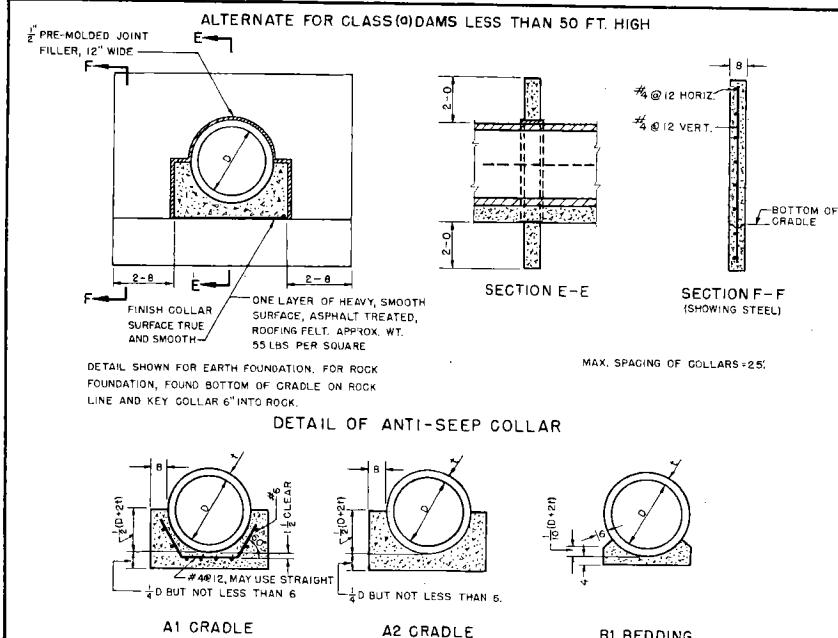
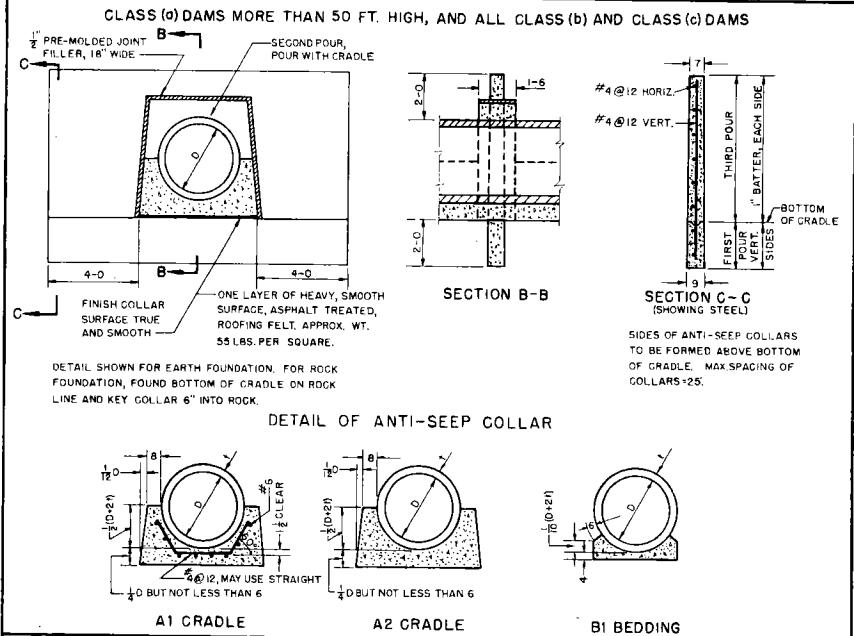
WHEN A1 CRADLE USED:  
CUT LONGITUDINAL BARS AT 3° FROM EACH  
SIDE OF ARTICULATION JOINT. USE NO DOWELS.



## PIPE JOINT DISPLACEMENT CHARACTERISTICS

L	J	OC
LENGTH OF PIPE SECTION	REQD. JOINT EXTENSIBILITY	REQD. JOINT ROTATION CAPACITY
FEET	INCHES	RADIANS

PRIOR APPROVAL OF PIPE AND PIPE JOINT DETAIL PROPOSED FOR USE, TO BE REQUIRED BY THE SPECIFICATIONS.



### PIPE AND CRADLE OR BEDDING ALTERNATES

MINIMUM THREE EDGE BEARING TEST STRENGTH LOAD IN POUNDS PER LINEAL FOOT OF PIPE FOR CORRESPONDING PIPE AND CRADLE OR BEDDING

CRADLE OR BEDDING	PIPE SPECIFICATION	LOAD TO PRODUCE NOT MORE THAN 0.01 INCH CRACK	LOAD TO PRODUCE NOT MORE THAN 0.001 INCH CRACK
A1	C-300		
	C-301		
	C-302		
A2	C-300		
	C-301		
	C-302		
ASTM	A-106		
	A-333		
	A-53		

### SCOPE:

1. Pipe Diameters:  
D=24", 30, 36, 42, and 48

### CRITERIA:

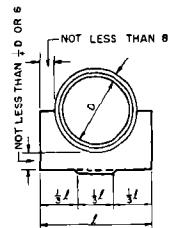
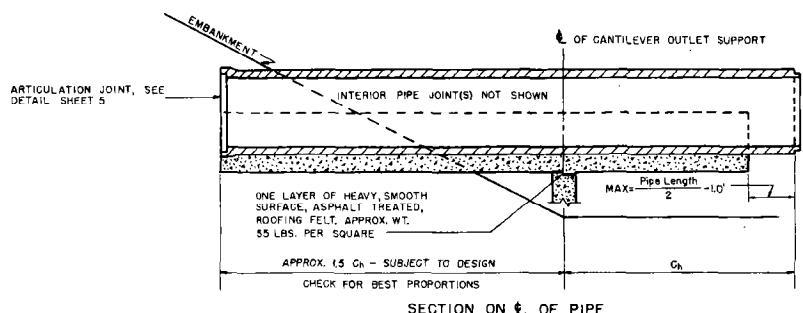
1. Materials (except pipe):
  - Concrete: Class B, f'c=4000 psi, f'c=1500 psi
  - Reinforcing Steel: Intermediate grade
2. Applicable Criteria:
  - Engineering Memorandum SCS-27
  - Engineering Memorandum SCS-42 (rev. 2)
  - Technical Release No. 5
  - Technical Release No. 19

### DROP INLET SPILLWAYS STANDARD FOR PIPE CONDUITS

U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

Engineering Div. Date Approved by  
Drawing No. 1-63 Title  
E.S.A. Date Issued  
Drawing No. 1-63 Date Issued  
E.S.A. Date Issued



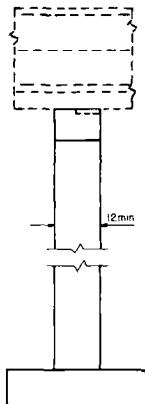


**SCOPE:**  
Pipe Diameters:  
D=24", 30, 36, 42, and 48

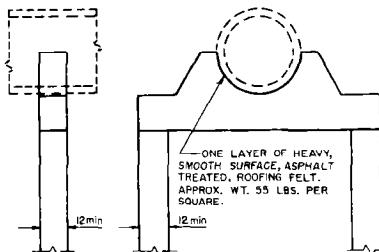
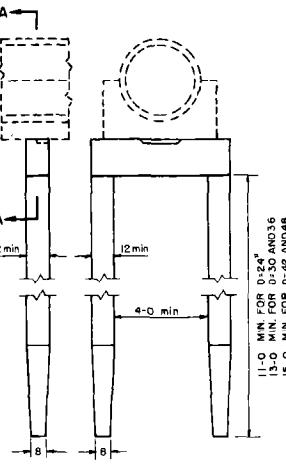
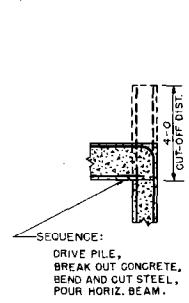
**CRITERIA:**  
Materials:  
Concrete: Class B, f<sub>c</sub>=4000 psi, f<sub>t</sub>=1000 psi.  
Reinforcing Steel: Intermediate grade

### BENTS FOR CANTILEVER OUTLETS

STANDARDS TO BE PREPARED FOR THE THREE TYPES, FIELD TO SELECT BENT DESIRED



HEIGHT DETERMINED BY FIELD CONDITIONS



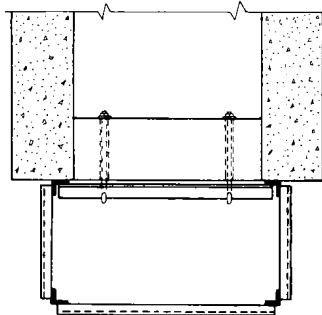
THIS BENT DETAIL FOR USE WITH  
CONCRETE STEEL CYLINDER PIPE  
HAVING SUFFICIENT STRENGTH AND  
LENGTH SUCH THAT A Poured CAN-  
TILEVER OUTLET BEAM IS NOT REQUIRED

### DROP INLET SPILLWAYS STANDARD FOR PIPE CONDUIT OUTLETS

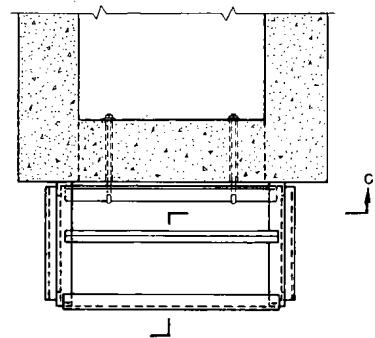
U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

Date: 1-63 Approved by: \_\_\_\_\_  
Design: ENGINEERING DIV. Time: \_\_\_\_\_  
Drawn: E.S.A. Drawn: \_\_\_\_\_  
Check: \_\_\_\_\_

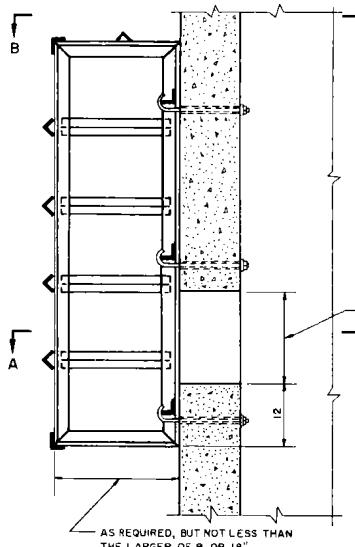




SECTION A—A



SECTION B—B



SECTION C—C

GENERAL NOTE:

LOW STAGE INLET DETAILS TO BE HANDLED AS A MODIFICATION  
OF THE STANDARDS BY THE FIELD.  
THIS SHEET CONTAINS DETAILS AND INFORMATION RECOMMENDED  
FOR USE WITH THE STANDARDS.

SCOPE:

1. These details apply to the standard covered top, rectangular open top, and square open top risers.

CRITERIA:

1. Trushracks:

Required net area for National Standard Detailed Drawings—to be computed from  $G_{max}$  for the low stage inlet and an allowable average velocity of 2.0 fps. Grating may be used at low stage inlet level, but required net area is exclusive of any grated area.

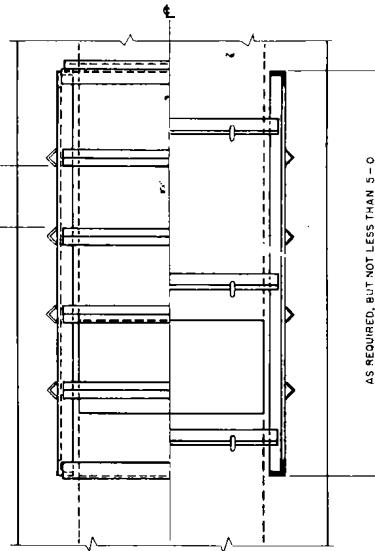
Fabrication—may be welded or bolted. Welded shown here.

All bolts, nuts, pipe sleeves, and grating to be galvanized or otherwise protected by corrosion resistant coating except when made of aluminum.

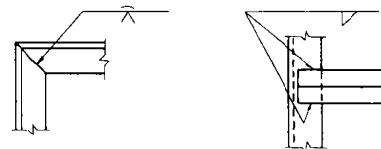
Number and spacing of  $\frac{3}{8}$ " bolts  $\frac{3}{4}$ " pipe sleeves and support angles to be determined as required for strength and rigidity.

2. Materials:

Structural steel or structural aluminum.



SECTION C—C



WELDING DETAILS

ENGINEERING DIVISION - DESIGN SECTION	
ENGINEERING APPROVAL	CARTOGRAPHIC APPROVAL
DESIGNED BY	DRAWN BY
CHECKED BY	STANDARD ENG. NO.

**DROP INLET SPILLWAYS  
RECOMMENDATIONS FOR  
LOW STAGE INLETS**

U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

Date \_\_\_\_\_ Approved by \_\_\_\_\_

Drawn ENGINEERING DIV. J-63 Title \_\_\_\_\_

Drawn E.S.A. J-63 Sheet \_\_\_\_\_ Drawn No. \_\_\_\_\_

Traced J.H.D. 2-52 Title \_\_\_\_\_ Drawn No. \_\_\_\_\_



# STRUCTURAL DESIGN: CIRCULAR CURVE, DIMENSIONING AND LAYOUT FOR REINFORCED CONCRETE SECTIONAL PIPE.

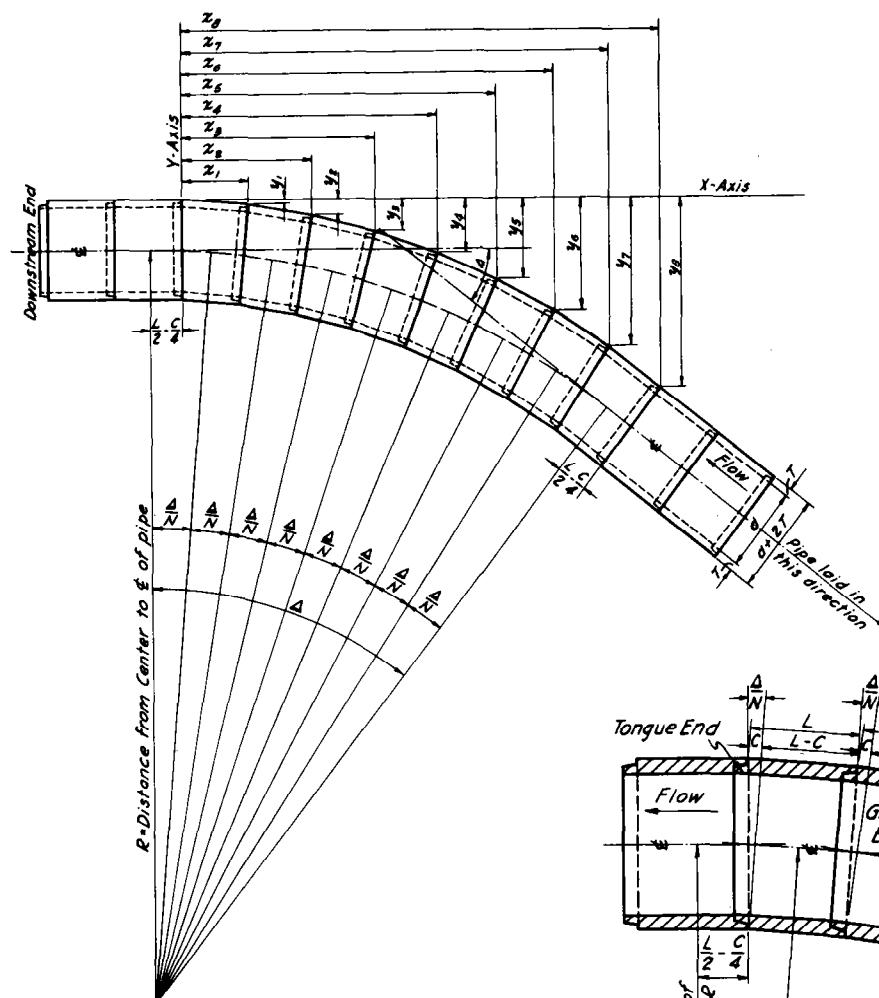


Fig. 1

## FORMULAS

$$1. \tan \frac{\Delta}{N} = \frac{C}{d+2T}; \text{ Largest recommended } \frac{\Delta}{N} = 5^\circ$$

$$R = \frac{[2L-C]}{4C} \{ \sqrt{(d+2T)^2 + C^2} + (d+2T) \} - \text{ft.}$$

Since  $C$  is small compared to  $(d+2T)$  when  $\frac{\Delta}{N} \leq 5^\circ$ ,  $C^2$  may be neglected under the radical sign. Then

$$2. R = \text{approx. } \frac{(2L-C)(d+2T)}{2C} - \text{ft. if } \frac{C}{d+2T} < 0.08$$

$$3.(a) \quad x_1 = L \cos \frac{\Delta}{N} - \text{ft.}$$

$$(b) \quad x_2 = L [\cos \frac{\Delta}{N} + \cos 2(\frac{\Delta}{N})] - \text{ft.}$$

$$x_n = L [\cos \frac{\Delta}{N} + \cos 2(\frac{\Delta}{N}) + \cos 3(\frac{\Delta}{N}) + \dots + \cos n(\frac{\Delta}{N})] - \text{ft.}$$

$$x_n = L \left[ \frac{\sin(n+\frac{1}{2})(\frac{\Delta}{N}) - \sin \frac{1}{2}(\frac{\Delta}{N})}{2 \sin \frac{1}{2}(\frac{\Delta}{N})} \right] - \text{ft.}$$

$$4.(a) \quad y_1 = L \sin \frac{\Delta}{N} - \text{ft.}$$

$$(b) \quad y_2 = L [\sin \frac{\Delta}{N} + \sin 2(\frac{\Delta}{N})] - \text{ft.}$$

$$y_n = L [\sin \frac{\Delta}{N} + \sin 2(\frac{\Delta}{N}) + \sin 3(\frac{\Delta}{N}) + \dots + \sin n(\frac{\Delta}{N})] - \text{ft.}$$

$$y_n = L \left[ \frac{\cos \frac{1}{2}(\frac{\Delta}{N}) - \cos(n+\frac{1}{2})(\frac{\Delta}{N})}{2 \sin \frac{1}{2}(\frac{\Delta}{N})} \right] - \text{ft.}$$

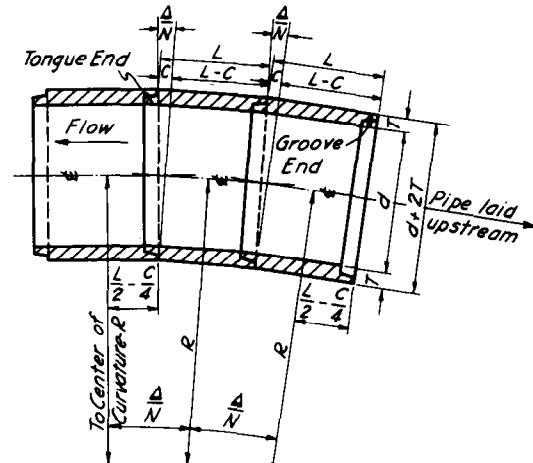


Fig. 2

## NOMENCLATURE AND SYMBOLS

$R$  = Radius of curvature - ft.; Distance from center of curve to £ of pipe.

$\Delta$  = Central angle of curve - Angle between £ tangents.

$N$  = Number of identically cut sections in curve.

$d$  = Inside diameter of pipe - ft.

$T$  = Wall thickness of concrete pipe - ft.

$L$  = Length of long side of elbow section - ft.

$C$  = Cut or bevel on tongue end of pipe section - ft. See Fig. 2.

$x_n$  = Offset dimension of outside edge of  $n^{\text{th}}$  section from Y-axis - ft.

$y_n$  = Offset dimension of outside edge of  $n^{\text{th}}$  section from X-axis - ft.

# STRUCTURAL DESIGN: CIRCULAR CURVE, DIMENSIONING AND LAYOUT FOR REINFORCED CONCRETE SECTIONAL PIPE.

## EXAMPLE

**Problem:** A reinforced concrete pipe with internal diameter of 60 inches and wall thickness of 6" is to be laid on a curve having a central angle ( $\Delta$ ) of  $38^{\circ}16'$ . The radius of curvature is to be kept as small as reasonably feasible using standard lengths of pipe and normal fabricating practice. Compute the required cut and coordinates for layout of this pipe curve.

**Solution:**

The radius of curvature ( $R$ ) will be smallest for short lengths ( $L$ ) of pipe and large values of  $\Delta/N$ . Choose a short standard length  $L=4'$  and hold  $\Delta/N$  as close to, but not over,  $5^{\circ}$  as possible. Choose number ( $N$ ) of cut sections of pipe in the curve as 8,

$$\frac{\Delta}{N} = \frac{38^{\circ}16'}{8} = 4^{\circ}47'$$

Solve for the cut ( $C$ ) as follows:

$$\tan(\Delta/N) = \tan 4^{\circ}47' = 0.08368$$

$$= \frac{C}{d+2T} = \frac{C}{60+12} = \frac{C}{72} \text{ or}$$

$$C = 0.08368 \times 72 = 6.02496 \text{ inches *}$$

This cut, to the closest  $1/8"$  for manufacturing purposes, is  $C=6.0$  inches. Tolerances for pipe cut  $C=6.0"$  will allow the use of the value  $C=6.02496"$  for calculation purposes thruout the rest of the problem. The radius of curvature ( $R$ ) of the  $\frac{1}{8}$  of the pipe is

$$R = \frac{(2L-C)(d+2T)}{2C}$$

$$= \frac{[8 - \frac{1}{12}(6.02496)][5 + (2 \times \frac{1}{12} \times 6)]}{2 \times \frac{1}{12} \times 6.02496}$$

$$R = 44.31 \text{ ft.}$$

The point of tangency of the curve is located

$$\left(\frac{L}{2} - \frac{C}{4}\right) = \frac{4}{2} - \frac{6.02496}{4 \times 12} = 1.87 \text{ ft.}$$

downstream from the first cut section to be placed. The offsets to the outside edge of pipe which will be used in laying the pipe are given on the form Calculation Sheet, sheet 3 of 3.

\*Permissible to use inches here if  $d$  &  $T$  are in inches.

REFERENCE

U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

ENGINEERING STANDARDS UNIT

STANDARD DWG. NO.

ES-8

SHEET 2 OF 3

DATE 1-10-50

**STRUCTURAL DESIGN: CIRCULAR CURVE, DIMENSIONING AND LAYOUT FOR REINFORCED CONCRETE SECTIONAL PIPE.**

**CALCULATIONS FOR OFFSETS**

$$x_n = L \left[ \cos \frac{\Delta}{N} + \cos 2 \left( \frac{\Delta}{N} \right) + \dots + \cos n \left( \frac{\Delta}{N} \right) \right] = L \sum_{j=1}^n \cos j \left( \frac{\Delta}{N} \right) - \text{ft.}$$

$n$	$n \frac{\Delta}{N}$	$\cos n \left( \frac{\Delta}{N} \right)$	$\sum_{j=1}^n \cos j \frac{\Delta}{N}$	$x_n = L \sum_{j=1}^n \cos j \frac{\Delta}{N} - \text{ft}$
1	4°-47'	0.99652	0.99652	3.99
2	9°-34'	0.98609	1.98261	7.93
3	14°-21'	0.96880	2.95141	11.81
4	19°-08'	0.94476	3.89617	15.58
5	23°-55'	0.91414	4.81031	19.24
6	28°-42'	0.87715	5.68746	22.75
7	33°-29'	0.83405	6.52151	26.09
8	38°-16'	0.78514	7.30665	29.23

Total (Check) 7.30665

$$y_n = L \left[ \sin \frac{\Delta}{N} + \sin 2 \left( \frac{\Delta}{N} \right) + \dots + \sin n \left( \frac{\Delta}{N} \right) \right] = L \sum_{j=1}^n \sin j \left( \frac{\Delta}{N} \right) - \text{ft.}$$

$n$	$n \frac{\Delta}{N}$	$\sin n \left( \frac{\Delta}{N} \right)$	$\sum_{j=1}^n \sin n \frac{\Delta}{N}$	$y_n = L \sum_{j=1}^n \sin j \frac{\Delta}{N} - \text{ft}$
1	4°-47'	0.08339	0.08339	0.33
2	9°-34'	0.16620	0.24959	1.00
3	14°-21'	0.24784	0.49743	1.99
4	19°-08'	0.32777	0.82520	3.30
5	23°-55'	0.40541	1.23061	4.92
6	28°-42'	0.48022	1.71083	6.84
7	33°-29'	0.55169	2.26252	9.05
8	38°-16'	0.61932	2.88184	11.53

Total (Check) 2.88184

REFERENCE

U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE  
ENGINEERING STANDARDS UNIT

STANDARD DWG. NO.

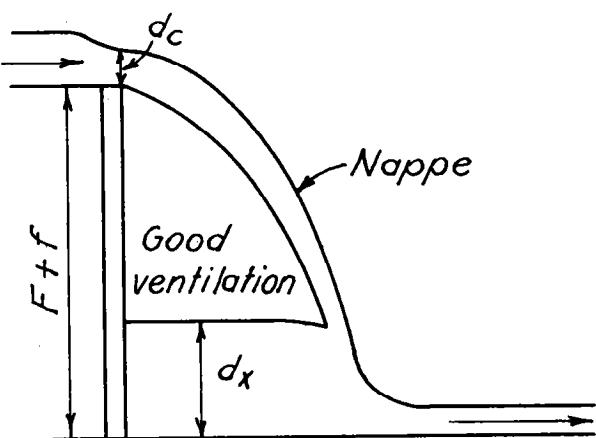
ES-8

SHEET 3 OF 3

DATE 1-10-50



# DROP SPILLWAYS: DEPTH OF STANDING WATER BEHIND NAPPE OF DROP SPILLWAY

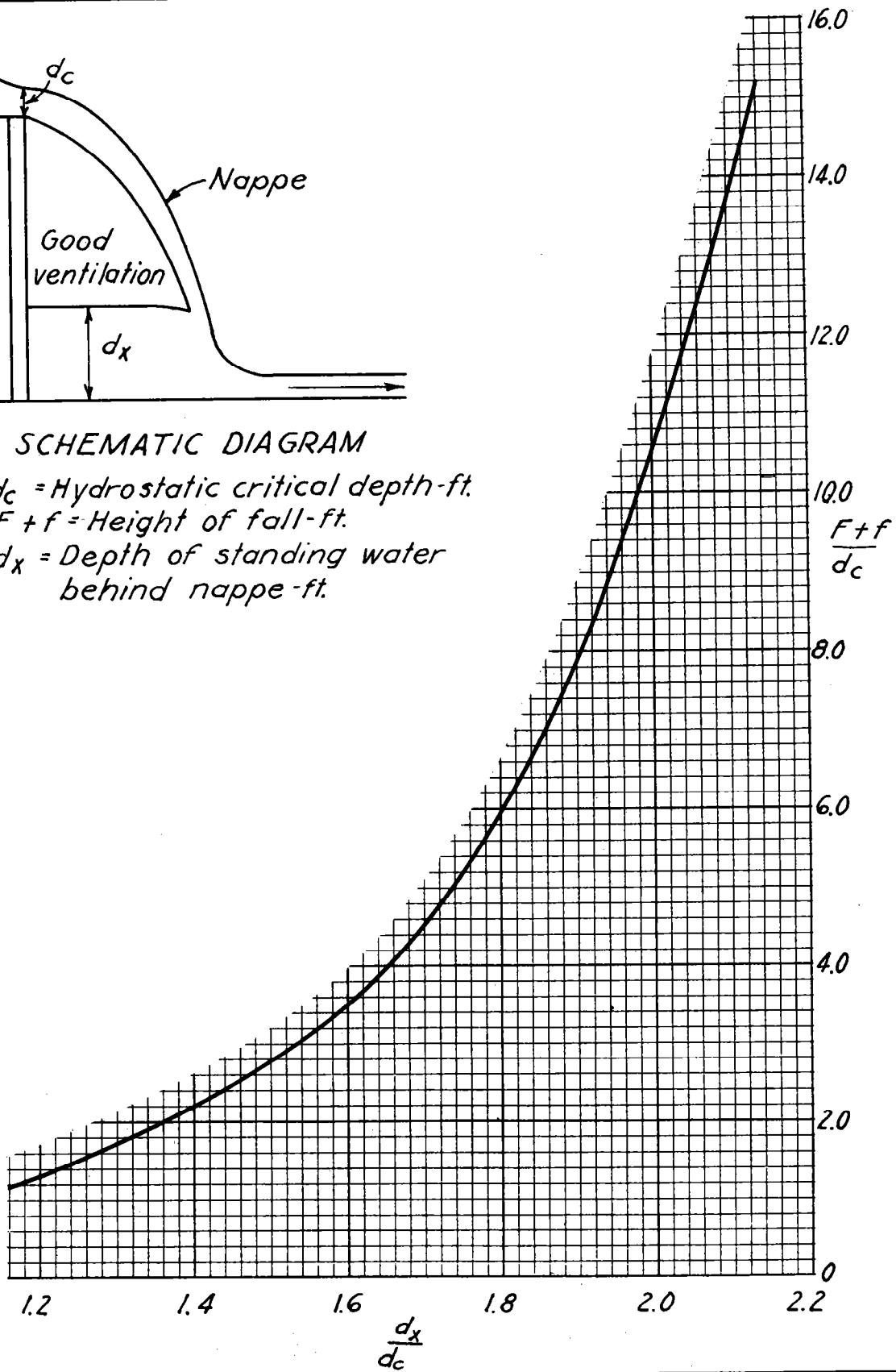


**SCHEMATIC DIAGRAM**

$d_c$  = Hydrostatic critical depth-ft.

$F+f$  = Height of fall-ft.

$d_x$  = Depth of standing water  
behind nappe-ft.



**REFERENCE**

Proceedings - ASCE Transaction  
No. 108, 1943, Paper No. 2204  
by Walter L. Moore, Page 1343

**U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE**

**ENGINEERING STANDARDS UNIT**

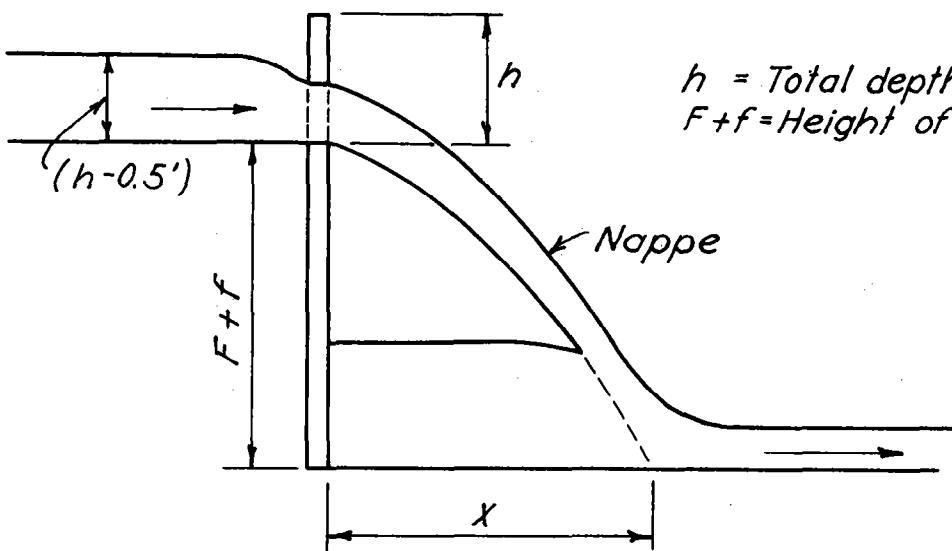
**STANDARD DWG. NO.**

**ES-11**

**SHEET 1 OF 2**

**DATE 1-27-50**

**DROP SPILLWAYS: APPROXIMATE HORIZONTAL DISTANCE, (X), TRAVELED BY THE NAPPE OVER A DROP SPILLWAY**



$h$  = Total depth of weir-ft.  
 $F+f$  = Height of fall-ft.

SCHEMATIC DIAGRAM

$$X = 1.185(F+f)^{\frac{1}{2}}(h-0.5)^{\frac{1}{2}}$$

		Value of $X$ in feet								
$F+f \backslash h$	$2'-0''$	$2'-6''$	$3'-0''$	$3'-6''$	$4'-0''$	$4'-6''$	$5'-0''$	$5'-6''$	$6'-6''$	
$4'-0''$	2.90	3.35	3.75	4.10	4.43	4.74	5.03	5.30	5.80	
$5'-0''$	3.25	3.75	4.18	4.59	4.96	5.30	5.62	5.92	6.49	
$6'-0''$	3.55	4.10	4.59	5.03	5.43	5.80	6.16	6.49	7.11	
$7'-0''$	3.84	4.44	4.96	5.43	5.87	6.27	6.65	7.01	7.68	
$8'-0''$	4.11	4.74	5.30	5.80	6.27	6.70	7.11	7.49	8.21	
$9'-0''$	4.35	5.03	5.62	6.16	6.65	7.11	7.54	7.95	8.71	
$10'-0''$	4.59	5.30	5.92	6.49	7.01	7.49	7.95	8.38	9.18	
$11'-0''$	4.81	5.56	6.21	6.81	7.35	7.86	8.34	8.79	9.63	
$12'-0''$	5.03	5.80	6.49	7.11	7.68	8.21	8.71	9.18	10.05	
$13'-0''$	5.23	6.04	6.76	7.40	7.99	8.55	9.06	9.55	10.46	
$14'-0''$	5.43	6.27	7.01	7.68	8.30	8.87	9.41	9.91	10.86	

Note: Velocity of approach neglected

REFERENCE

U. S. DEPARTMENT OF AGRICULTURE  
 SOIL CONSERVATION SERVICE

ENGINEERING STANDARDS UNIT

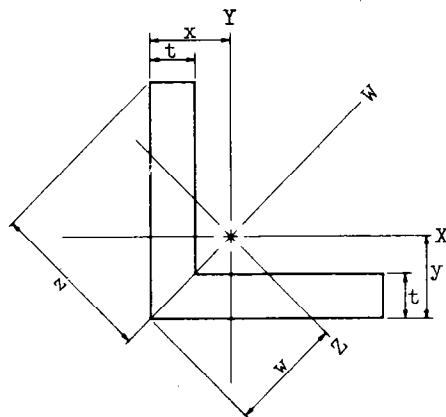
STANDARD DWG. NO.

ES-11

SHEET 2 OF 2

DATE 1-27-50

# STRUCTURAL DESIGN: STEEL ANGLES WITH EQUAL LEGS



Size in.	t in.	Weight lb/ft	Area in <sup>2</sup>	x or y in.	z in.	w in.	Axis Z-Z		
							I in <sup>4</sup>	S in <sup>3</sup>	r in.
8 x 8	1 1/8	56.9	16.7	2.41	5.66	3.41	40.8	12.0	1.56
	1	51.0	15.0	2.37	5.66	3.35	36.7	11.0	1.56
	7/8	45.0	13.2	2.32	5.66	3.28	32.6	9.93	1.57
	3/4	38.9	11.4	2.28	5.66	3.22	28.4	8.81	1.58
	5/8	32.7	9.61	2.23	5.66	3.16	24.1	7.62	1.58
	9/16	29.5	8.68	2.21	5.66	3.12	21.8	6.99	1.59
	1/2	26.4	7.75	2.19	5.66	3.09	19.6	6.34	1.59
6 x 6	1	37.4	11.0	1.86	4.24	2.64	15.0	5.69	1.17
	7/8	33.1	9.73	1.82	4.24	2.57	13.3	5.18	1.17
	3/4	28.7	8.44	1.78	4.24	2.51	11.6	4.63	1.17
	5/8	24.2	7.11	1.73	4.24	2.45	9.87	4.03	1.18
	9/16	21.9	6.43	1.71	4.24	2.41	8.98	3.72	1.18
	1/2	19.6	5.75	1.68	4.24	2.38	8.07	3.39	1.18
	7/16	17.2	5.06	1.66	4.24	2.35	7.15	3.04	1.19
	3/8	14.8	4.36	1.64	4.24	2.32	6.20	2.67	1.19
	5/16	12.4	3.65	1.62	4.24	2.29	5.23	2.29	1.20
	7/8	27.2	7.98	1.57	3.54	2.22	7.56	3.41	0.973
5 x 5	3/4	23.6	6.94	1.52	3.54	2.15	6.59	3.06	0.975
	5/8	19.9	5.86	1.48	3.54	2.09	5.60	2.68	0.978
	1/2	16.2	4.75	1.43	3.54	2.03	4.59	2.26	0.983
	7/16	14.2	4.18	1.41	3.54	2.00	4.07	2.04	0.986
	3/8	12.3	3.61	1.39	3.54	1.96	3.54	1.80	0.990
	5/16	10.3	3.03	1.37	3.54	1.93	2.99	1.55	0.994
	3/4	18.5	5.44	1.27	2.83	1.80	3.29	1.83	0.778
4 x 4	5/8	15.7	4.61	1.23	2.83	1.74	2.80	1.61	0.779
	1/2	12.8	3.75	1.18	2.83	1.67	2.29	1.37	0.782
	7/16	11.3	3.31	1.16	2.83	1.64	2.04	1.24	0.785
	3/8	9.73	2.86	1.14	2.83	1.61	1.77	1.10	0.788
	5/16	8.17	2.40	1.12	2.83	1.58	1.50	0.953	0.791
	1/4	6.59	1.94	1.09	2.83	1.55	1.22	0.793	0.795
	3 1/2 x 3 1/2	1/2	11.1	3.25	1.06	2.47	1.50	1.51	1.01
	7/16	9.77	2.87	1.04	2.47	1.46	1.35	0.919	0.684
	3/8	8.45	2.48	1.01	2.47	1.43	1.17	0.818	0.687
	5/16	7.11	2.09	0.990	2.47	1.40	0.995	0.710	0.690
	1/4	5.74	1.69	0.968	2.47	1.37	0.812	0.593	0.694

REFERENCE

U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE  
ENGINEERING DIVISION - DESIGN SECTION

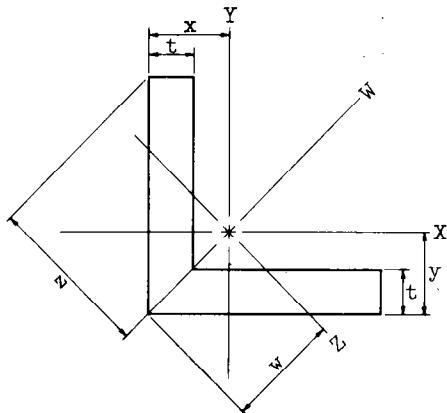
STANDARD DWG. NO.

ES- 157

SHEET 1 OF 2

DATE 4 - 64

# STRUCTURAL DESIGN: STEEL ANGLES WITH EQUAL LEGS



Size in.	t in.	Weight lb/ft	Area in <sup>2</sup>	x or y in.	z in.	w in.	Axis Z-Z		
							I in <sup>4</sup>	S in <sup>3</sup>	r in.
3 x 3	1/2	9.36	2.75	0.932	2.12	1.32	0.938	0.712	0.584
	7/16	8.28	2.43	0.910	2.12	1.29	0.833	0.647	0.585
	3/8	7.18	2.11	0.888	2.12	1.26	0.726	0.578	0.587
	5/16	6.05	1.78	0.865	2.12	1.22	0.617	0.504	0.589
	1/4	4.89	1.44	0.842	2.12	1.19	0.504	0.423	0.592
	3/16	3.71	1.09	0.820	2.12	1.16	0.388	0.334	0.596
2 1/2 x 2 1/2	1/2	7.66	2.25	0.806	1.77	1.14	0.533	0.468	0.487
	3/8	5.90	1.73	0.762	1.77	1.08	0.412	0.382	0.487
	5/16	4.98	1.46	0.740	1.77	1.05	0.350	0.335	0.489
	1/4	4.04	1.19	0.717	1.77	1.01	0.287	0.283	0.491
	3/16	3.07	0.902	0.694	1.77	0.982	0.221	0.225	0.495
2 x 2	3/8	4.63	1.36	0.636	1.41	0.899	0.206	0.229	0.389
	5/16	3.92	1.15	0.614	1.41	0.868	0.175	0.201	0.390
	1/4	3.19	0.938	0.592	1.41	0.837	0.143	0.171	0.391
	3/16	2.43	0.715	0.569	1.41	0.805	0.111	0.138	0.394
	1/8	1.65	0.484	0.546	1.41	0.773	0.0766	0.0991	0.398
1 3/4 x 1 3/4	1/4	2.76	0.813	0.529	1.24	0.748	0.0947	0.127	0.341
	3/16	2.11	0.621	0.506	1.24	0.716	0.0733	0.102	0.343
	1/8	1.44	0.422	0.484	1.24	0.684	0.0507	0.0742	0.347
1 1/2 x 1 1/2	1/4	2.34	0.688	0.466	1.06	0.659	0.0586	0.0890	0.292
	3/16	1.79	0.527	0.444	1.06	0.628	0.0454	0.0723	0.293
	1/8	1.22	0.359	0.421	1.06	0.596	0.0315	0.0529	0.296
1 1/4 x 1 1/4	1/4	1.91	0.563	0.403	0.884	0.570	0.0333	0.0585	0.243
	3/16	1.48	0.434	0.381	0.884	0.539	0.0257	0.0477	0.244
	1/8	1.01	0.297	0.359	0.884	0.507	0.0179	0.0353	0.246
1 x 1	1/4	1.49	0.438	0.339	0.707	0.480	0.0168	0.0350	0.196
	3/16	1.16	0.340	0.318	0.707	0.450	0.0129	0.0286	0.194
	1/8	0.798	0.234	0.296	0.707	0.418	0.00896	0.0214	0.196

REFERENCE

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

ENGINEERING DIVISION - DESIGN SECTION

STANDARD DWG. NO.

ES- 157

SHEET 2 OF 2

DATE 4-64